New Hampshire's
Particulate Matter 2.5 – Federal Reference Method
Quality Assurance Project Plan (PM2.5 QAPP)

January 2005
Revision 4

Prepared by

The New Hampshire
Department of Environmental Services

ELEMENT 1 – Title and Approval Sheet

1.1 Title

New Hampshire's Particulate Matter 2.5 – Federal Reference Method Quality Assurance Project Plan ("PM2.5 QAPP").

New Hampshire Department of Environmental Services - Air Resources Division - Technical Services Bureau ("DES") has developed this PM2.5 QAPP to guide the Air Monitoring Program in the collection of PM2.5 data. This PM2.5 QAPP will become effective upon being signed by select DES and United States Environmental Protection Agency ("EPA") officials, as prescribed in Section 1.2 below.

1.2 Approval

The following DES officials hereby approve this PM2.5-QAPP and commit to the elements contained herein.

1) Signature: _____ Date:_____
Robert Scott –Director – DES Air Resources Division

2) Signature: _____ Date:_____
Joanne Morin – Administrator – DES Technical Services Bureau

3) Signature: _____ Date:_____
Kendall Perkins – Program Manager – DES Air Monitoring Program

4) Signature: _____ Date:_____
James Poisson - Quality Assurance Supervisor – DES Air Monitoring Program

5) Signature:_____ Date:_____
Vince Perelli – Quality Assurance Manager – DES

The following EPA officials hereby approve this PM2.5 QAPP and commit to the elements contained herein.

1) Signature: _____ Date:_____
Dick Siscanaw – EPA Region I - Quality Assurance Chemist

2) Signature: _____ Date:_____
Paul Bryan – EPA Region I – EPA Project Officer

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ELEMENT 3 – Distribution List

3.1 DES Distribution List

Once effective, DES will distribute this PM2.5 QAPP to the following DES individuals involved in New Hampshire's PM2.5 Monitoring Program:

Robert R. Scott
Kent R. Finemore
Kendall Perkins
James Poisson
Timothy Verville
Glenn R. Mathison
Thomas Fazzina
Normajean Smith
Scott Klose
Leonard Raposa
Dan Terrell

3.2 EPA Distribution List

Once effective, DES will distribute this PM2.5 QAPP to the following EPA individuals involved in New Hampshire's PM2.5 Monitoring Program:

Katrina Kipp
Paul Bryan
Norman Beloin
Dick Siscanaw
Alan VanArsdale
Wendy McDougal

3.3 Supplementary Distribution List

Once effective, DES will distribute this PM2.5 QAPP to the following individual involved in New Hampshire's PM2.5 Monitoring Program:

Lisa Greene, Research Triangle Institute

ELEMENT 4 – Problem Definition/Background

4.1 History

Between 1900 and 1970 the emissions of air pollutants in the United States increased significantly. Six air pollutants, called the criteria pollutants, were designated by the Clean Air Act of 1970, as the primary causes of human health and environmental problems. Air pollution control strategies were developed to reduce the emissions of these criteria pollutants: particulate matter, sulfur dioxide, ozone, nitrogen dioxide, carbon monoxide, and lead. Over the past thirty years the standards for most air pollutants have remained constant, and the control strategies have been effective in reducing the ambient concentration of pollutants.

The criteria pollutant defined as particulate matter is a general term used to describe a broad class of substances that exist as liquid or solid particles, over a large range of sizes. Unlike the other criteria pollutants, particulate matter has undergone several changes in the standard. The first standard for particulate matter, total suspended particles (TSP) included all particles, large and small. This standard was replaced by the PM10 standard in 1989. This standard was set for smaller sizes particles, those of approximately 10 micrometers in diameter, or less. The current standard, PM2.5, is based on "respirable" size particles.

As part of the Ambient Air Quality Monitoring Program for particulate matter, EPA has set two particle size fractions; those less than or equal to 10 micrometers (PM10), and those less than or equal to 2.5 micrometers (PM2.5). This QAPP for the measurement of particulate matter focuses on the quality assurance (QA) activities associated with the New Hampshire PM2.5 ambient monitoring program.

The background and rational for the implementation of the PM2.5 ambient monitoring network can be found in the Federal Register. In general, some of the findings are listed below.

- The characteristics, sources, and potential health effects of larger or "coarse" particles (greater than 2.5 micrometers in diameter) and smaller or "fine" particles (less than 2.5 micrometers in diameter) are very different.

- Coarse particles generally come from sources such as windblown dust from unpaved roads, open agricultural fields, sand and gravel operations, and deserts (to name a few sources).

- Fine particles, on the other hand, are generally directly or indirectly emitted from industrial manufacturing activities, residential fuel use (oil and wood burning), electricity generation, combustion of fuels in motor vehicles and other transportation sector sources, and from natural sources. Fine particles are "indirectly" formed in the atmosphere from chemical transformation of gases such as sulfur dioxide, nitrogen oxides and ammonia, and volatile organic compounds (VOC), that are emitted form combustion and non-combustion sources.

- Coarse particles can be deposited in the upper portion of the respiratory system and contribute to health effects such as aggravation of asthma. The EPA "staff paper" concludes that fine particulate matter, which can deposit deep into the lung, has a greater potential to contribute to serious health effects, the symptoms of which can lead to hospital admissions and premature mortality, as cited in recently published epidemiological studies.

- The recent community epidemiological studies find that adverse public health effects are associated with exposures to particles at levels far below the PM10 standards for short-term (~1 day to less than 5 days) and long-term (one or more years) periods.

- The health effects that have been noted in the epidemiological studies include premature death and hospital admissions to the emergency room (primarily among the elderly and individuals with cardiopulmonary disease); increased respiratory problems and respiratory disease (such as the incidence and intensity of asthma among children and individuals with cardiopulmonary disease); a decreased ability of the lung to function correctly; alterations in the lung tissue and its structure; and changes in the respiratory system's defense system.

Air quality samples are generally collected for one or more of the following purposes:

- To determine compliance with and/or progress towards meeting the National Ambient Air Quality Standards.
- To develop, modify or activate control strategies that prevent or alleviate air pollution problems.
- To observe regional pollution trends, including trends in the concentrations of pollutants in non-urban areas.
- To provide a data base for research and evaluation of public health and environmental effects.

With the end use of the air quality samples as a prime consideration, various network designs can be employed to meet one, or more, of the six basic monitoring objectives listed below:

- Determine the highest concentrations that occur in the area covered by the network.
- Determine representative concentrations in areas of high population density.

- Determine the influence of significant sources and source categories on ambient pollution levels.
- Determine general background concentration levels.
- Determine the extent of regional pollutant transport among and between urban areas and source regions, and support the secondary standards.
- Determine the welfare-related effects in rural and remote regions.

Historically, New Hampshire has followed the federal monitoring requirements and guidelines promulgated by the US EPA, and has operated air monitoring sampling programs to collect and quantify particulate matter. The particulate matter sampling program began in 1975, when a network of TSP samplers was deployed around the state. This network began the characterization of particulate matter in New Hampshire. In 1987, the US EPA reviewed the particulate matter standard, and modified the PM standard in accordance with the best scientific information available for the review. New Hampshire, in response to this PM new standard, deployed a network of roughly a dozen PM10 monitoring sites throughout the state. This network continues to exist and has been enhanced by the next generation of PM samplers, which measure PM2.5. Most of these PM2.5 samplers are co-located with existing PM10 samplers, in order to compare data from the two networks and establish ratios of particle sizes. New Hampshire intends to operate this new network for about ten years.

4.2 The Monitoring Network

The network consists of four major categories of monitoring stations (for monitoring criteria pollutants). These types of stations are described below.

- The **SLAMS** (State and Local Air Monitoring Stations) air monitoring network consists of ~3,500 monitoring stations nationwide. The number of sites and their location in each state is determined by the needs of the State and local air pollution control agencies as determined by the State Implementation Plan (SIP) requirements.
- The **NAMS** (National Air Monitoring Stations) air monitoring network is composed of ~1,100 stations nationwide. These sites are a subset of the SLAMS and are used to monitor urban and multi-source air pollution. In general, these sites provide ambient measurements in areas of maximum concentrations an high population density.
- The **PAMS** (Photochemical Assessment Monitoring Stations) network provides measurements of ozone precursors in ozone non-attainment areas that are designated as serious, severe, or extreme (as defined in the Clean Air Act Amendments of 1990). These networks are composed of three to five stations, which provide upwind, center city, near city, downwind, and far downwind measurements of ozone precursors. Nationwide, more than 90 PAMS stations will be deployed by the year 2000.
- **Special Purpose Monitoring Stations** (SPMS) are deployed to provide measurement data for special studies that State and local agencies can use to support SIP efforts and other air program activities. These sites are not permanent and are used to supplement the fixed monitoring network. If data collected from SPMS are used for SIP purposes,

then all QA and methodology requirements of the SLAMS network must be met.

ELEMENT 5 – Project/Task Organization

Element 5 identifies the various organizations and individuals participating in this PM2.5 Monitoring Program. This element summarizes specific roles and responsibilities for those organizations and individuals responsible for implementation of this PM2.5 QAPP.

5.1 Organizational Roles and Responsibilities

EPA and DES are responsible for developing and implementing this PM2.5 Monitoring Program. Other State, local and private entities play a secondary role in site placement, logistics, monitoring and duration. The responsibilities of each organization are as follows.

5.1.1 Office of Air Quality Planning and Standards ("OAQPS")

OAQPS is the organization charged under the authority of the Clean Air Act (CAA) to protect and enhance the quality of the nation's air resources. OAQPS evaluates the need to regulate potential air pollutants, develops national standards, works with State and local agencies to develop plans for meeting these standards, monitors national air quality trends, maintains a database of information on air pollution, provides technical guidance and training on air pollution control strategies, and monitors compliance with air pollution standards. OAQPS sets standards for pollutants considered harmful to public health or welfare, and in cooperation with EPA's Regional Offices and the States, enforces compliance with the standards through state implementation plans ("SIP"s) and regulations controlling emissions from stationary sources.

The Monitoring and Quality Assurance Group ("MQAG"), within the OAQPS' Emissions Monitoring and Analysis Division, is responsible for oversight of the Ambient Air Quality Monitoring Network. MQAG has the following responsibilities with respect to the PM 2.5 QAPP:

- To approve methods and procedures used in making air pollution measurements to ensure the programs objectives and resulting data are of satisfactory quality
- To operate the National Performance Audit Program ("NPAP") and the Federal Reference Method ("FRM") Performance Evaluations
- To evaluate performance, through technical systems audits and management systems reviews of organizations making air pollution measurements
- To implement a satisfactory quality assurance program over EPA's Ambient Air Quality Monitoring Network
- To ensure that national regional laboratories are available to support reference standards comparisons and QA programs
- To ensure that QA guidance are written and revised as necessary
- To provide technical assistance to the EPA Regional Offices and air pollution monitoring community

5.1.2 EPA Region 1 Office

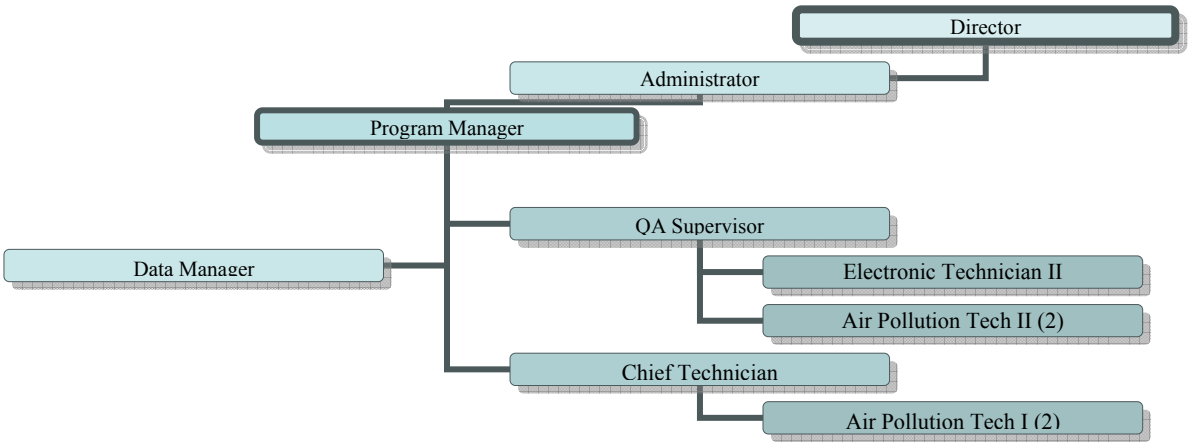
EPA is responsible for developing NAAQS, defining data quality necessary to make comparisons to the NAAQS, assessing data quality, supporting OAQPS with implementation of the NPAP, supporting DES with technical information relative to the PM2.5 Monitoring Program and providing a liaison between OAQPS/EPA and DES by making available the technical and QA information developed by the federal government. Other EPA responsibilities include reviewing Quality Assurance Project Plans, evaluating quality system performance, through technical systems audits and network reviews and coordinating QA matters at the Regional level with the State and local agencies.

5.1.3 DES

In New Hampshire, DES is the air pollution control agency primarily responsible for the development and implementation of the PM2.5 Monitoring Program and this related PM2.5 QAPP. This QAPP shall meet the data quality requirements for all phases of the environmental data operation ("EDO") which includes field and laboratory work, and any contractor work used to obtain data. An EDO is defined as work performed to obtain, use, or report information pertaining to environmental processes or conditions. DES responsibilities also include assessing the quality of the data and taking corrective action when appropriate.

Figure 5.1 represents the organizational structure of DES relative to the PM2.5 Monitoring Program.

Figure 5.1: DES' PM2.5 Program Organizational Structure



5.2 Individual Roles and Responsibilities

DES individual roles and responsibilities are as follows:

- *Robert R. Scott, Director*. The Director is responsible for overall management of the Air Resources Division. He is responsible for decisions pertaining to air quality legislation, policies and programs in the State of New Hampshire. The Director will use data from the PM 2.5 Monitoring Program for decision making pertaining to attainment of the National Ambient Air Quality Standards for fine particulate matter.
- *Kent R. Finemore, Deputy Director*. The Deputy Director is responsible for grants management and administration for the Air Resources Division. This individual exercises oversight of program spending and performance. The Deputy Director is also responsible for Management System Reviews.
- *Joanne Morin, Administrator*, Technical Services Bureau. The Administrator of the Technical Services Bureau is responsible to the Director for overseeing the implementation of air monitoring programs, i.e., PM 2.5, and ensuring that they are carried out in conformance with applicable requirements. The Administrator uses data from this program in decision making related to other Bureau programs.
- *Kendall Perkins, Air Monitoring Program Manager*. The Program Manager is responsible for the design, deployment and operation of the PM 2.5 program as well as the daily oversight of the program. The Program Manager ensures that the PM2.5 Monitoring Program is carried out in conformance with all applicable requirements and ensures that all personnel within the program are adequately trained in the operation and maintenance of the network. The Program Manager is responsible for procuring third party contracts for PM2.5 filter weighing. The Program Manager reviews data from the monitoring network, both as a quality assurance check, and as an assessment tool to confirm the design of the network. This person is also responsible for initiating Management System Reviews and ensuring the assessment and evaluation of DES' PM2.5 data.
- *James Poisson, Air Monitoring Quality Assurance Supervisor*. The Quality Assurance Supervisor is responsible for all QA work and issues related to DES' PM2.5 Monitoring Program. The Quality Assurance Supervisor is also responsible for coordinating PM2.5 sampler maintenance - and preparation, updates and corrective action relative to this PM2.5 QAPP.
- *Tim Verville, Chief Air Pollution Technician*. The Chief Air Pollution Technician is responsible for managing equipment operation, monitoring sites, scheduling site visits, scheduling routine quality assurance checks and dealing with personnel issues related to network operation, i.e., sick days, vacations, etc.
- *Normajean Smith, Air Monitoring Technician II*. This Technician II position is responsible for PM2.5 filter shipping, receiving, tracking and distribution. This Technician II also operates electronic filter tracking systems and coordinates with third party laboratories (Research Triangle Institute) relative to PM2.5 filter issues. This Technician II also takes responsibility for a limited amount of Technician I responsibility (see below)

- *Glenn Mathison, Electronic Technician II*. This individual is responsible for conducting PM2.5 analyzer maintenance and tracking thereof.
- *Len Raposa and Scott Klose, Air Pollution Technician I's*. These individuals are the site operators who are responsible for the routine filter changing and maintenance on the PM 2.5 samplers. They perform the day-to-day requirements on the samplers. Each Technician I is responsible for transporting the sample filters from the field sites to the laboratory within prescribed specifications.
- *Dan Terrell, Data Manager*. The data manager is responsible for electronic data handling, coordinating electronic file's with third party laboratories and uploading quality assured data to the Aeromatic Information Retrieval System (AIRS).

Third Party Laboratory responsibilities are as follows:

- *Research Triangle Institute (RTI)*. RTI personnel conduct PM2.5 filter weighing in accordance with EPA approved protocols and procedures.

EPA responsibilities are as follows:

- *Alan VanArsdale and Mary Jane Cuzzupe, EPA*. These individuals are responsible, at the federal level, for approval, oversight, auditing and monitoring of the DES PM 2.5 sampling program.

ELEMENT 6 – Project/Task Description

6.1 PM 2.5 Sampling Strategy

This PM2.5 Monitoring Program is a multi-year initiative designed to collect air samples throughout the State of New Hampshire for the purpose of determining whether or not the ambient air concentrations of PM2.5 exceed the health standard set by the EPA. DES has placed PM2.5 samplers in both populated urban areas as well as in remote rural locations. This deployment strategy helps DES determine to what extent any PM2.5 problem is localized in the urban areas, or if PM2.5 is of a more uniform distribution (statewide) due to regional area sources of PM 2.5 emissions and transport from sources outside of the New England area.

DES has designed the PM2.5 sampling network in accordance with the Guidance for Network Design and Optimum Site Exposure for PM2.5 and PM10. EPA has approved this network design.

6.1.1 Filter Data

DES collects air samples for fine particulate matter on 46.2 mm polytetrafluoroethylene (PTFE) filters, at a flow rate of 16.67 liters per minute for 24 hours, using Anderson RAAS2.5, and BGI PQ200 samplers. DES operates 5 sites will on a sampling schedule of every three days (1 in 3) and 5 sites on a sampling schedule of every six days (1 in 6). Results of this sample collection, after appropriate laboratory analysis, indicate the approximate concentration of PM2.5 in micrograms per cubic meter in the ambient air. DES compares sample results to the national primary and secondary ambient air quality standards for particulate matter contained in *40 CFR Part 50, Appendix I.*

6.1.2 PM 2.5 Samplers

Part 50, Appendix L of the 7/18/97 Federal Register Notice specifies the performance requirements of the PM 2.5 air samplers. Table 6.1 summarizes some of the more critical performance requirements.

Table 6.1 Design/Performance Specifications for PM2.5 Samplers

Equipment	Frequency	Acceptance Criteria	Reference
Filter Design Specs.	Vendor Cert.	see reference	40 CFR Pt. 50, App.L Sec 6.0
Size	"	46.2 mm dia ± 0.25mm	" Sec 6.1
Medium	"	Polytetrafluoroethylene	" Sec 6.2
Support ring	"	Polymethylpentene	" Sec 6.3
	"	0.38mm thick	"
	"	46.2 mm ± 0.25mm outer dia.	"
	"	3.68 (±0.00, -0.51mm) width	"
Pore size	"	2 µm	"Sec 6.4

Table 6.1 Design/Performance Specifications for PM2.5 Samplers			
Equipment	**Frequency**	**Acceptance Criteria**	**Reference**
Filter thickness	"	30-50 µm	"Sec 6.5
Max. pressure drop	"	30 cm H_2O @ 16.67L/min	"Sec 6.6
Max. Moisture pickup	"	10 µg increase in 24 hr.	"Sec 6.7
Collection efficiency	"	99.7%	"Sec 6.8
Filter weight stability	"	<20 µg	"Sec 6.9.1 and 6.9.2
Alkalinity	"	< 25.0 microequivalents/gram	"Sec 6.10
Sampler Performance Specs.	All Instruments		
Sample Flow Rate	"	1.000 m^3/hr.	40 CFR Pt. 50, App.L Sec7.4
Flow Regulation	"	1.000 ± 5% m^3/hr.	"
Flow Rate Precision	"	2% CV	
Flow Rate Accuracy	"	±2%	"
External Leakage	"	Vendor specs	"
Internal Leakage	"	Vendor specs	"
Ambient Temp Sensor	"	-30° - 45° C 1° C res. ±1.6°C accuracy	Vol-II -MS. 2.12 40 CFR Pt. 50, App.L Sec7.4
Filter Temp Sensor	"	-30° - 45° C 0.1° C res. ±1.0°C accuracy	"
Barometric Pressure	"	600-800 mm Hg 5 mm res. ±10mm accuracy	"
Clock/Timer	"	Date/time. 1 sec. res. ± 1 min/month accuracy	"

Other than required federal reference or equivalent air samplers, there are no special personnel or equipment requirements. Element 15 of this QAPP lists equipment requirements for DES' PM2.5 data collection operations.

6.1.3 Field Measurements

Table 6.2 represents the field measurements that are required. The sampler electronically records these measurements and stores them until the field operator can down load the information during routine visits.

Table 6.2 Field Measurement Requirements							
Information to be provided	**Appendix L section reference**	**Availability**				**Format**	
		Anytime[a]	**End of period[b]**	**Visual display[c]**	**Data output[d]**	**Digital reading[e]**	**Units**
Flow rate, 30-second maximum interval	7.4.5.1	_	—	_	✶	XX.X	L/min
Flow rate, average for the sample period	7.45.2	✶	_	✶	_	XX.X	L/min
Flow rate, CV, for the sample period	7.4.5.2	✶	_	✶	_●	XX.X	%
Flow rate, 5-min average out of spec.							

Table 6.2 Field Measurement Requirements

Information to be provided	Appendix L section reference	Availability				Format	
		Anytime[a]	End of period[b]	Visual display[c]	Data output[d]	Digital reading[e]	Units
(FLAG)[f]	7.4.5.2	_	_	_	_ ●	On/Off	
Sample volume, total	7.4.5.2	✶	_	_	_ ●	XX.X	m^3
Temperature, ambient, 30-second interval	7.4.8	_	—	_	—	XX.X	°C
Temperature, ambient, min., max., average for the sample period	7.4.8	✶	_	_	_ ●	XX.X	°C
Barometric pressure, ambient, 30-second interval	7.4.9	_	—	_	—	XXX	mm Hg
Barometric pressure, ambient, min., max., average for the sample period	7.4.9	✶	_	_	_ ●	XXX	mm Hg
Filter temperature, 30-second interval	7.4.11	_	—	_	—	XX.X	°C
Filter temperature, differential, 30-minute interval, out of spec. (FLAG)[f]	7.4.11	✶	_	_	_ ●	On/Off	
Filter temperature, maximum differential from ambient, date, time of occurrence	7.4.11	✶	✶	✶	✶	X.X, YY/MM/DD HH:mm	°C, Yr/Mo/ Day Hr min
Date and time	7.4.12	_	—	_	—	YY/MM/DD HH:mm	Yr/Mo/ Day Hr min
Sample start and stop time settings	7.4.12	_	_	_	_	YY/MM/DD HH:mm	Yr/Mo/ Day Hr min
Sample period start time	7.4.12	—	_	_	_ ●	YYYY/MM M/DD HH:mm	Yr/Mo/ Day Hr min
Elapsed sample time	7.4.13	✶	_	_	_ ●	HH:mm	Hr min
Elapsed sample time out of spec. (FLAG)[f]	7.4.13	—	_	_	_ ●	On/Off	
Power interruptions >1 min, start time of first 10	7.4.15.5	✶	_	✶	_	1HH:mm, 2HH:mm, etc.	Hr min
User-entered information, such as sampler and site identification	7.4.16	_	_	_	_ ●	As entered	

_ Provision of this information is required.

✶ Provision of this information is optional. If information related to the entire sample period is optionally provided prior to the end of the sample period, the value provided should be the value calculated for the portion of the sampler period completed up to the time the information is provided.

● Indicates that this information is also required to be provided to the AIRS data bank.

a Information is required to be available to the operator at any time the sampler is operating, whether sampling or not.

b Information relates to the entire sampler period and must be provided following the end of the sample period until reset manually by the operator or automatically by the sampler upon the start of a new sample period.

c Information shall be available to the operator visually.

d Information is to be available as digital data at the sampler's data output port following the end of the sample period until

reset manually by the operator or automatically by the sampler upon the start of a new sample period.

[e] Digital readings, both visual and data output, shall have no less than the number of significant digits and resolution specified.

[f] Flag warnings may be displayed to the operator by a single-flag indicator or each flag may be displayed individually. Only a set (on) flag warning must be indicated; an off (unset) flag may be indicated by the absence of a flag warning. Sampler users should refer to Section 10.12 of Appendix L regarding the validity of samples for which the sampler provided an associated flag warning.

In addition to the measurements collected in Table 6-2, the following information identified in Table 6.3 will be recorded. These parameters are explained in Appendix L, *Guidance Document 2.12* .

Table 6-3 Additional Field Measurements

Parameter	Parameter Code	Frequency	Units	Comment
Monitor ID	MONID	Every sample event	see AIRS	Unique AIRS Monitor ID that include the combination of STATE, COUNTY, SITE, PARAMETER, and POC fields
Site Name	SITENAM	Every sample event	AAA...	Unique site name associated with the site
Sampler ID	SAMPID	Every sample event	AAXXX	Sampler model number or unique bar code number associated with the model number
QC Thermometer ID Initial	QCTIDI	Every sample event	AAAXXX	Unique ID number of QC thermometer used for ambient air temp check at the beginning of sampling
QC Temperature Measurement Initial	QCTEMPI	Every sample event	XX^{o}C	QC temp reading at the beginning of sampling
QC Baromter ID Initial	QCBIDI	Every sample event	AAAXXX	Unique alpha-numeric ID of QC barometric pressure device used for barometric pressure reading check
QC Bar. Pressure Reading Initial	QCBI	Every sample event	XXX mm Hg	QC temp reading at the beginning of sampling
QC Thermometer ID Final	QCTIDF	Every sample event	AAAXXX	Unique ID number of QC thermometer used for ambient air temp check at the beginning of sampling
QC Temperature Measurement Final	QCTEMPF	Every sample event	XX^{o}C	QC temp reading at the end of sampling
QC Baromter ID Final	QCBIDF	Every sample event	AAAXXX	Unique alpha-numeric ID of QC barometric pressure device used for barometric pressure reading check
QC Bar. Pressure Reading Final	QCBF	Every sample event	XXX mm Hg	QC temp reading at the end of sampling
Filter ID	FID	Every sample event	AAYYXXXX	Unique filter ID of filter given by the weighing laboratory.
Filter Integrity flag	FFIF	Every sample event	QFI/ VFI/GFI	QFI -Questionable filter integrity VFI- Void Filter Integrity GFI-Good Filter Integrity

Table 6-3 Additional Field Measurements				
Site Operator Initial	SOI	Every sample event	AAA	Initials of the site operator setting up the sampling run
Site Operator Final	SOF	Every sample event	AAA	Initials of the site operator completing the sampling run
Free Form Notes	FFM	As needed	AAA....	Free form notes about the sampling run

Sample filters collected in the PM2.5 Monitoring Program are handled under more rigid protocols than previous filter based sampling programs. The time constraints within which functions must be performed are very demanding on both site operators and weighing room staff. Additionally, the number of filters that must be processed annually is greater than in previous sample programs due in part to the increased sample frequency at number of the sites. Filter handling, preparation, weighing and archiving will be done in accordance with the requirements of 40 *CFR Part 50, the Quality Assurance Guidance Document 2.12* (Appendix L) and this PM2.5 QAPP.

6.2 Project Assessment Techniques

An assessment is an evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation (PE), management systems review (MSR), peer review, inspection, or surveillance. Definitions for each of these activities can be found in the glossary (Appendix A). Element 20 of this QAPP will discuss assessment techniques in more detail.

Table 6.4 will provide information on the parties implementing the assessment and there frequency.

Table 6.4 Assessment Schedule		
Assessment Type	**Assessment Agency**	**Frequency**
Technical Systems Audit	EPA Regional Office	1 every 3 years
Management System Reviews	DES	1 every 3 years
Network Review	EPA Regional Office Department's Air Division	every year App D 1/year App E 1 every 3 years
FRM Performance Evaluation	EPA Regional Office	25% of sites/year/4 times per year.
Data Quality Assessment	DES	every year

6.3 Project Records

DES maintains procedures for the timely preparation, review, approval, issuance, use, control, revision and maintenance of documents and records. Table 6.5 represents the categories and types of records and documents which are applicable to document control for PM2.5 information. Information on key documents in each category are explained in more detail in Element 9 of this QAPP.

Table 6.5 Critical Documents and Records

Categories	**Record/Document Types**
Management and Organization	State Implementation Plan Reporting agency information Organizational structure Personnel qualifications and training Training Certification Quality management plan Document control plan EPA Directives Grant allocations Support Contract
Site Information	Network description Site characterization file Site maps Site Pictures
Environmental Data Operations	QA Project Plans Standard operating procedures (SOPs) Field and laboratory notebooks Sample handling/custody records Inspection/maintenance records
Raw Data	Any original data (routine and QC data) including data entry forms
Data Reporting	Air quality index report Annual SLAMS air quality information Data/summary reports Journal articles/papers/presentations
Data Management	Data algorithms Data management plans/flowcharts $PM_{2.5}$ Data Data Management Systems
Quality Assurance	Good Laboratory Practice Network reviews Control charts Data quality assessments QA reports System audits Response/Corrective action reports Site Audits

ELEMENT 7 – Quality Objectives and Criteria

DES, EPA and other stakeholders use data collected by the PM2.5 Monitoring Program for a variety purposes. DES uses PM2.5 data to make decisions that have a wide range of impacts. Data Quality Objectives ("DQO"s) include a full set of performance constraints needed to ensure that the data is of adequate quality for the decision being made; decision makers need to feel confident that their data are of adequate quality for the decision being made. DQOs specify the level of uncertainty that a decision maker is willing to accept to make a decision. However, the decision maker should understand that data are never error free and always contain some level of uncertainty. Serious political, economic and health consequences may result from decisions based on erroneous data. Therefore, decision makers need to understand and set limits on the probabilities of making incorrect decisions with this data.

The operational details and procedures being applied in DES' PM2.5 Monitoring Program are in accordance with the requirements contained within the publications listed in Appendix A of this document. DQO's and Measurement Quality Objectives (MQO's) for the New Hampshire PM2.5 Monitoring Program are presented in Table 7.1 of this Element. Table 7.1 details MQO requirements and acceptance criteria that DES applies in the PM2.5 sampling program.

7.1 Data Quality Objectives

DQO's are qualitative and quantitative statements derived from the DQO process – see *Guidance for Data Quality Objective Process [EPA QA/G4]* - that clarify the monitoring objectives, define the appropriate type of data, and specify the tolerable levels of decision errors for the monitoring program. By applying the DQO process to the development of a quality system for PM2.5, EPA and the DES guard against committing resources to data collection efforts that do not support a defensible decision.

Regarding the quality of the PM2.5 measurement system, the objective is to control precision and bias in order to reduce the probability of decision errors by decision makers. Assumptions necessary for the development of the DQO's include:

1. The DQO is based on the annual arithmetic mean of the NAAQS.

2. There will be a normal distribution for measurement error.

3. Decision errors can occur when the estimated 3-year average differs from the actual, or true, 3-year average.

4. The limits on precision and bias are based on the smallest number of sample values that can be expected in a 3-year period.

5. The decision error limits were set at 5%.

6. Measurement imprecision was established at 10% coefficient of variation (CV).

Once a DQO is established, the quality of the data must be evaluated and data bias and precision controlled to ensure that it is maintained within the established acceptance criteria.

The primary DQO of the PM2.5 measurement system is to limit imprecision and bias in order to reduce the probability of making decision errors to 5% or less.

7.2 Measurement Quality Objectives

Once a DQO is established, the quality of the data must be evaluated and controlled to ensure that it is maintained within the established acceptance criteria. MQOs are designed to evaluate and control various phases (sampling, preparation, analysis) of the measurement process to ensure that total measurement uncertainty is within the range prescribed by the DQOs. MQOs can be defined in terms of precision, bias, representativeness, detectability, completeness, and comparability.

For each of these attributes, acceptance criteria are developed for various phases of the PM2.5 Monitoring Program. In theory, if these MQOs are met, measurement uncertainty should be controlled to the levels required by the DQO. Table 7-1 details the MQOs for the PM2.5 Monitoring Program.

Table 7.1 Measurement Quality Objectives - Parameter PM 2.5				
Requirement	**Frequency**	**Acceptance Criteria**	**40 CFR Reference**	**QA Guidance Document 2.12 Reference**
Filter Holding Times				
Pre-sampling	all filters	< 30 days before sampling	Part 50, App.L Sec 8.3	Sec. 7.9
Post-sampling Weighing	"	< 10 days at 25^{O} C from sample end date < 30 days at 4^{O}C from sample end date	" "	Sec. 7.11 "
Reporting Units	All data	µg/m^3	Part 50.3	Sec. 11.1
Detection Limit				
Lower DL	All data	2 µg/m^3	Part 50, App.L Sec 3.1	
Upper Conc. Limit	All data	200 µg/m^3	Part 50, App.L Sec 3.2	
Data Completeness	quarterly	75%	Part 50, App. N, Sec. 2.1	
Filter				
Visual Defect Check	All Filters	See reference	Part 50, App.L Sec 6.0	Sec 7.5
Filter Conditioning Environment				
Equilibration	All filters	24 hours minimum	Part 50, App.L Sec 8.2	Sec. 7.6
Temp. Range	"	20-23^{o} C	"	"
Temp. Control	"	± 2^{o} C over 24 hr	"	"
Humidity Range	"	30% - 40% RH	"	"
Humidity Control	"	± 5% RH over 24 hr.	"	"
Lot Blanks	3 filters per exposure lot	less than 15 µg change between weighings		Sec. 7.7
Lab QC Checks				
Field Filter Blank	10% or 1 per weighing session	±30 µg change between weighings	Part 50, App.L Sec 8.2	Sec. 7.7
Lab Filter Blank	10% or 1 per weighing	±15 µg change between	"	"

Table 7.1 Measurement Quality Objectives - Parameter PM 2.5				
Requirement	**Frequency**	**Acceptance Criteria**	**40 CFR Reference**	**QA Guidance Document 2.12 Reference**
Balance Check	session beginning, every 10th sample, end	weighings ≤3 µg		Sec. 7.9
Duplicate Filter Weighing	1 per weighing session	±15 µg change between weighings		Sec 7.11
Calibration/Verification				
Flow Rate (FR) Calibration	If multi-point failure	± 2% of transfer standard	Part 50, App.L, Sec 9.2	Sec 6.3
FR multi-point verification	1/yr	± 2% of transfer standard	Part 50, App.L, Sec 9.2.5	Sec 6.3 & 8.4
One point FR verification	1/4 weeks	± 4% of transfer standard		Sec 8.4
External Leak Check	1/4 weeks	80 mL/min	Part 50, App.L, Sec 7.4	Sec. 6.6 & 8.4
Internal Leak Check	1/4 weeks	80 mL/min	"	Sec. 6.6 & 8.4
Temperature Calibration	If multi-point failure	± 2% of standard	Part 50, App.L, Sec 9.3	Sec. 6.4
Temp Multi-point Verification	on installation, then 1/yr	± 2°C of standard	Part 50, App.L, Sec 9.3	Sec. 6.4 and 8.4
One- point temp Verification	1/4 weeks	± 4°C of standard	"	Sec. 6.4 and 8.4
Pressure Calibration	on installation, then 1/yr	±10 mm Hg	"	Sec. 6.5
Pressure Verification	1/4 weeks	±10 mm Hg	"	Sec. 8.2
Clock/timer Verification	1/ 4 weeks	1 min/mo	Part 50, App.L, Sec 7.4	not described
Accuracy				
FRM Performance Evaluation	25% of sites 4/yr	± 10%	Part 58, App A, Sec 3.5	Sec 10.2
Flow Rate Audit	1/2wk (automated) 4/yr (manual)	± 4% of audit standard	"	Sec. 10.2
External Leak Check	4/yr	< 80 mL/min	not described	"
Internal Leak Check	4/yr	< 80 mL/min	not described	"
Temperature Audit	4/yr	± 2°C	not described	"
Pressure Audit	4/yr (?)	±10 mm Hg	not described	"
Balance Audit	1/yr	Manufacturers specs	not described	"
Precision				
Collocated samples	every 6 days for 15% of sites	CV ≤ 10%	Part 58, Vol 67 No 251 not described	Sec. 10.2
Single analyzer	1/3 mo.	CV ≤ 10%	not described	not described
Single Analyzer	1/ yr	CV ≤ 10%		not described

Table 7.1 Measurement Quality Objectives - Parameter PM 2.5

Requirement	Frequency	Acceptance Criteria	40 CFR Reference	QA Guidance Document 2.12 Reference
Reporting Org.	1/ 3 mo.	CV ≤ 10%	not described	not described
Calibration & Check Standards				
Flow Rate Transfer Std.	1/yr	±2% of NIST-traceable Std.	Part 50, App.L Sec 9.1 and 9.2	Sec. 6.3
			not described	
Field Thermometer	1/yr	± 0.1° C resolution	not described	Sec 4.2 & 6.4
		± 0.5° C accuracy	not described	"
Field Barometer	1/yr	± 1 mm Hg resolution	not described	"
		± 5 mm Hg accuracy	not described	"
Working Mass Stds.	3-6 mo.	0.025 mg	not described	Sec 4.3 and 7.3
Primary Mass Stds.	1/yr	0.025 mg		"

Element 8 - Special Training /Certification

Training for the PM2.5 Monitoring Program will range from in-house work sessions to vendor sponsored formal training. Overall responsibility for training will resides with the Program Manager with assistance from the EPA regional office. Personnel assigned to the PM2.5 activities will meet the educational, work experience, responsibility, personal attributes, and training requirements for their positions. Equipment utilized for conducting quality assurance checks on PM2.5 analyzers is certified and traceable to National Institute of Standards and Technology (NIST) standards. Training and certification issues relative to specific program components are as follows:

Laboratory – All filters generated as part of the PM2.5 Monitoring Program are analyzed by a contract laboratory. Any laboratory contracted by DES for the PM2.5 Monitoring Program has a proven track record and is approved by EPA.

Field Operations - Training of field staff on the operational and maintenance requirements of the fine particle sampling program is provided by the Quality Assurance Supervisor and the Chief Technician. Instrument specific training is provided by the vendor and the Chief Technician. "Hands on experience" is seen as the most valuable training tool for the successful operation of the fine particle samplers in a field situation.

Data Management - The Data Manager is responsible for the integration and reporting of both laboratory and field operations data. Reportable data in this program will is received from a number of different sources and requires a certain amount of manipulation before it is submitted to the AIRS database. Training for this effort is provided by the EPA guidance documents, EPA regional data contacts and consultation with other state air agencies.

Over the years, a number of courses have been developed for personnel involved with ambient air monitoring and quality assurance programs. Formal QA/QC training is offered through the following organizations:

- Air Pollution Training Institute (APTI) *http://www.epa.gov/oar/oaq.apti.html*
- Air & Waste Management Association (AWMA) *http://awma.org/epr.htm*
- American Society for Quality Control (ASQC) *http://www.asqc.org/products/educat.html*
- EPA Institute
- EPA Quality Assurance Division (QAD) *http://es.inel.gov/ncerqa/qa/*
- EPA Regional Offices

Table 8-1 presents a sequence of core ambient air monitoring and QA courses for ambient air monitoring staff, and QA managers (marked by asterisk). The suggested course sequences assume little or no experience in QA/QC or air monitoring. Persons having experience in the subject matter described in the courses would select courses according to their appropriate

experience level. Courses not included in the core sequence would be selected according to individual responsibilities, preferences, and available resources.

Table 8-1. Core Ambient Air Training Courses

Sequence	Course Title (SI = self instructional)	Department Number	Source
1*	Air Pollution Control Orientation Course (Revised), SI:422	422	APTI
2*	Principles and Practices of Air Pollution Control, 452	452	APTI
3*	Orientation to Quality Assurance Management	QA1	QAD
4*	Introduction to Ambient Air Monitoring (Under Revision), SI:434	434	APTI
5*	General Quality Assurance Considerations for Ambient Air Monitoring (Under Revision), SI:471	471	APTI
6*	Quality Assurance for Air Pollution Measurement Systems (Under Revision), 470	470	APTI
7*	Data Quality Objectives Workshop	QA2	QAD
8*	Quality Assurance Project Plan	QA3	QAD
9	Atmospheric Sampling (Under Revision), 435	435	APTI
10	Analytical Methods for Air Quality Standards, 464	464	APTI
11	Chain-of-Custody Procedures for Samples and Data, SI:443	443	APTI
*	Data Quality Assessment	QA4	QAD
*	Management Systems Review	QA5	QAD
*	Beginning Environmental Statistical Techniques (Revised), SI:473A	473	APTI
*	Introduction to Environmental Statistics, SI:473B	473B	APTI
*	Quality Audits for Improved Performance	QA6	AWMA
*	Statistics for Effective Decision Making	STAT1	ASQC
	AIRS Training	AIRS1	OAQPS

Table 8-1. Core Ambient Air Training Courses

Sequence	Course Title (SI = self instructional)	Department Number	Source
*	FRM Performance evaluation Training (field/lab)	QA7	OAQPS
*	$PM_{2.5}$ Monitoring Implementation (Video)	PM1	OAQPS

- Courses recommended for QA Managers

Based upon PM2.5 Monitoring Program activities, the following training will be available to personnel in the following categories.

Field Personnel- 422, 434, 435, 443, PM1

Laboratory- 422, 434, 435, 464, 443, PM1

Data Management - 434, AIRS1

QA Personnel - 422, 434, 435, 443, QA1, QA3, QA4, QA6, QA7, PM1

Element 9 – Documentation and Records

Record keeping for the PM2.5 Monitoring Program is in accordance with the requirements of the regulation and the guidance provided in *Section 12.0 of the Quality Assurance Guidance Document 2.12: Monitoring PM2.5 In Ambient Air Using Designated Reference or Class I Equivalent Methods* (Appendix L). A document, from a records management perspective, is any volume that contains information which describes, defines, specifies, reports, certifies, or provides data or results pertaining to an environmental program. Records are: books, papers, maps, photographs, machine readable materials, or other documentary materials, regardless of physical form or characteristics, made or received by an agency of the government under authority of law or in connection with the transaction of public business and preserved or appropriate for preservation by that agency or its legitimate predecessor as evidence of the organization, functions, policies, decisions, procedures, operations, or other activities of the government or because of the informational value of the data contained in them. Table 9-1 lists areas of the program where records and documents (with example codes) will be generated and used.

Records will be kept in both hard copy, e.g., field maintenance and QA forms, and in electronic format, e.g., 5 minute sampler flow/temperature and pressure data from each individual sample run. DES uses several forms when conducting PM2.5 Monitoring Program QA checks. These forms are available in Appendix B of this PM2.5 QAPP. Coordination of all record keeping for this project will reside with the Quality Assurance Supervisor of the Air Monitoring Program.

The following information describes DES' document and records procedures for the PM2.5 Program. Table 9-1 (PM2.5 Records and Documentation) provides information about the documents and record types that are associated with various categories and operations in the PM2.5 Program.

9.1 Annual Summary Reports Submitted to EPA

As required in *40 CFR Part 58*, DES submits to the EPA Administrator, through the Region I Office, an annual summary report of all the ambient air quality monitoring data from all monitoring stations designated as SLAMS. The report is submitted by July 1 of each year for the data collected from January 1 to December 31 of the previous year. The report contains the following information:

- **Site and Monitoring Information**
  - City name (when applicable).
  - County name and street address of site location.
  - AIRS-AQS site code.
  - AIRS-AQS monitoring method code.

· **Summary Data**

Annual arithmetic mean (ug/m3) as specified in *40 CFR Part 50, Appendix N* (Annual arithmetic mean NAAQS is 15 ug/m3).
All daily PM-fine values above the level of the 24-hour PM-fine NAAQS (65 ug/m3) and the dates of the occurrence.
Sampling schedule used (every six days, every three days, etc.).
Number of 24-hour average concentration in their ranges listed below:

Range	# of values
0-15 (ug/m3)	
16-30	
31-50	
51-70	
71-90	
91-110	
greater than 110	

DES' Air Resources Division Director, as the senior air pollution control officer for the New Hampshire Air Resources Division, certifies that the annual summary is accurate to the best of his/her knowledge. This certification is based on the various assessments and reports performed by DES.

9.2 Written Records and Documentation

Table 9-1 presents the hand-written documents and records that DES uses as part of the PM2.5 Monitoring Program. DES fills out all hard copy information in indelible ink, and corrects information by inserting one line through incorrect entries. The individual making corrections initials and dates them. Copies of all PM2.5 related forms can be found in Appendix B.

9.2.1 Technician Notebooks.

DES issues a notebook to each field technician. Although data entry forms are associated with all routine environmental data operations, field technicians use the notebooks to record additional information about PM2.5 operations.

9.2.2 Station Notebooks

DES also has Station Notebooks at each sampling site. These are typically 3-ring binders containing data inspection and maintenance forms. DES also includes Standard Operating Procedures (SOPs) in these 3-ring binders.

9.2.3 Filter Notebooks

DES maintains a notebook containing information on all filters. This notebook includes all of the "results sheets" returned from the weighing laboratory in chronological order by site.

9.2.4 Sample Shipping/Receipt Notebooks

DES also maintains a notebook that includes all PM2.5 shipping/receiving information. This notebook also contains standard forms used in the PM2.5 shipping/receiving process including the chain of custody forms.

9.2.5 Pink Slips

PM2.5 Monitoring Program personnel fill out Pink Slips whenever equipment malfunctions. Information on the Pink Slip. The Electronics Technician II uses information from the Pink Slips to coordinate repairs and log malfunctions into an electronic database.

9.2.6 Equipment Transfer Forms

PM2.5 Monitoring Program personnel fill out Equipment Transfer Forms whenever they move equipment from one place to another. One of the Technician IIs, currently Normajean Smith, is responsible for logging the Transfer Form information into an electronic database.

9.2.7 Run Data Sheets

PM2.5 Monitoring Program personnel who collect the sample filters fill out a Run Data Sheet. Technicians record specific run data on this sheet. This Run Data Sheet can also serve as back-up information in case the electronic download of run data malfunctions.

9.3 Electronic Records and Documentation

DES keeps all electronic records and documentation in a secure network that is routinely backed up. DES' keeps electronic records of primarily two types, Sampler Run Data and Laboratory Filter Data.

9.3.1 Sampler Run Data

PM2.5 instruments provide an automated means for collecting sample run data. Technicians use a small electronic memory device "Widget" to extract run data as they collect the filters. The Chief Technician is responsible for downloading the Widgets to an electronic database at DES headquarters in Concord. Widget records are stored in the DES Network directory: T:\Transfer\Datbase\aqs\PM2.5\Widget . Further information on these systems is described in Elements 18 and 19 of this PM2.5 QAPP, but basically the widget transfers data relative to sampler flow, temperature and pressure for the sample period.

9.3.2 Laboratory Filter Data

DES receives filter data from RTI via email in the form of Microsoft Excel spreadsheets. Data on these spreadsheets from RTI include Filter ID, Lot #, dates and blank information. These spreadsheets also have initial and final filter information like relative humidity, temperatures and weights (mg). The Data Manager uploads this spreadsheet into a Microsoft Access database specifically designed for accepting the data and preparing the data for uploading to the EPA AIRS database. This Access database is called PDMT. PDMT combines the widget data with the RTI data and calculates the overall filter loading in ug/m^3.

9.4 Data Reporting - Archiving and retrieval

As stated in *40 CFR Part 31.42*, in general, DES retains all of the information listed in Table 9-1 for 3 years from its generation date. However, if any litigation, claim, negotiation, audit or other action involving records has been started before the expiration of the 3 year period, then DES retains the records until the completion of the action and a resolution of all issues arises.

Table 9.1 - PM2.5 Records and Documentation

Categories	Record/Document Types	Type	Location
Management and Organization	State Implementation Plan	B	Administrator
	Reporting agency information	B	Program Manager
	Organizational structure	B	Director
	Personnel qualifications and training	H	Program Manager
	Training Certification	H	Program Manager
	Quality management plan	B	Program Manager
	Document control plan	B	Director
	EPA Directives	B	Director
	Grant allocations	B	Director
	Support Contract	B	Program Manager
Site Information	Network description	B	Administrator
	Site characterization file	E	Program Manager
	Site maps	B	Program Manager
	Site Pictures	E	Program Manager
Environmental Data Operations	QA Project Plans	B	Program Manager
	Standard operating procedures (SOPs)	B	Program Manager
	Field and laboratory notebooks	H	Technicians
	Sample handling/custody records	H	Technician II
	Inspection/Maintenance records	B	Electronic Tech
Raw Data	PDMT Database	E	Data Manager
	Excel Spreadsheets	E	Data Manager
	Widget data	E	Data Manager
	Any original data (routine and QC data) including data entry forms	B	Program Manager
Data Reporting	Air quality index report	B	Administrator
	Annual SLAMS air quality information	B	Administrator
	Data/summary reports	B	Administrator
	Data management plans/flowcharts	B	Program Manager

Table 9.1 - PM2.5 Records and Documentation			
Categories	**Record/Document Types**	**Type**	**Location**
Data Management	PM2.5 Data	E	Data Manager
	Data Management Systems	E	Data Manager
Quality Assurance	Network reviews	B	Administrator
	Control charts	E	Program Manager
	QA reports	B	QA Supervisor
	System audits	B	EPA/QA Supervisor
	Response/Corrective action reports	B	QA Supervisor
	Site Audits	H	Chief Technician
E – Electronic file H – Hard copy only B – Both electronic and hardcopy			

9.5 Documentation Control

Table 9-1 also presents the type (electronic, Hardcopy or both) and person responsible for each record generated/maintained in the PM2.5 Monitoring Program. The details of these various documents and records are discussed in the appropriate sections of this document.

DES collects all raw data required for the calculation of a PM2.5 concentration, the submission to the AIRS database, and QA/QC data, electronically or on data forms that are included in the field and analytical methods sections of this PM2.5 QAPP.

ELEMENT 10 – Sampling Process Design

In designing a monitoring strategy for fine particulate material, DES followed the network design guidance provided by the Federal Regulations *40 CFR Parts 53 and 58***.** EPA approved the network design plan that DES submitted in September of 1998. The current network design plan includes a list of sites, a schedule of sample frequencies and the objective of each monitor in the network (see Table 10.1).

DES' network design components comply with the regulations stipulated in *40 CFR Part 58 Section 58.13, Appendix A and Appendix D* and further described in *Guidance for Network Design and Optimal Site Exposure for PM2.5 and PM10* (*Appendix J and H*). DES monitors PM2.5 at 10 locations using FRM samplers (Graseby Anderson RAAS2.5-300, Graseby Andersen RAAS2.5-100 and BGI Inc. PQ200). Table 10.1 lists PM2.5 network information including location, objective, collocated samplers and sample frequency.

Table 10.1 - DES' PM2.5 Sampling Network

Sampler Location	Sampler Site Objective	AIRS #	Co-located (PM10/TEOM/QA)	Frequency (Sample/Day)
Portsmouth – Pierce Island	Population	330150014	yes/yes/no	1/3
Lebanon - Airport	Background	330090008	no/yes/no	1/6
Manchester - Pearl St.	Population	330110019	yes/yes/yes	1/3
Nashua – Crown Street	Population	330111010	no/no/no	1/3
Pembroke – Exchange Street	Population	330131006	no/no/no	1/3
Peterboro – Pack Monadnock	Transport	330115001	no/yes/no	1/6
Laconia – Green Street	Background	330012004	no/no/yes	1/6
Berlin - Lancaster St.	Source Impact	330070014	no/no/no	1/3
Claremont - South St.	Transport	330190003	no/no/no	1/6
Keene - Railroad St.	Population	330050007	yes/no/no	1/6

10.1 Design Rational

The primary purpose of DES' PM2.5 air monitoring network is to measure compliance with the national standards for particulate matter. These standards are laid out in *40 CFR Part 50 (Appendix I)*, and are based on twenty-four hour average concentrations as summarized below:

(1) The three-year average of the annual 98th percentiles of PM2.5 concentrations at any population-oriented monitoring site is not to exceed 65 ug/m3.

(2) The three-year average of the annual mean of PM2.5 concentrations is not to exceed 15 ug/m3. The average may be based on a single community-oriented monitoring site or may be based on the spacial average of community-oriented monitoring sites in a

community monitoring zone (CMZ).

The design of the SLAMS PM2.5 network achieves one of six basic monitoring objectives, as described in *40 CFR Part 58, Appendix D* (Appendix J). These are:

(1) To determine the highest concentrations expected to occur in the area covered by the network.
(2) To determine representative concentrations in areas of high population density.
(3) To determine the impact on ambient pollution levels of significant sources or source categories.
(4) To determine general background concentrations levels.
(5) To determine the extent of Regional pollution transport among populated areas.
(6) In support of secondary standards, to determine the welfare-related impacts in more rural and remote areas.

DES has relied on both local knowledge of pollution and national guidance in developing its PM2.5 air monitoring sites. DES is confident that the sampling frequency for the New Hampshire PM-fine monitoring network is sufficient to attain the desired confidence in the annual 98th percentile and annual mean PM2.5 concentrations in the vicinity of the monitoring sites, by complying with the sampling frequency requirements of *40 CFR Part 58 Section 58.13*. Finally, by adhering to the rules laid out by *40 CFR Part 58, Appendix D* (and *Guidance for Network Design and Optimum Site Exposure for PM2.5 and PM10*) for selecting sampler locations DES is confident that the locations chosen for its PM2.5 monitoring sites adequately characterize the ambient PM2.5 concentrations.

10.2 Co-location for Bias and Precision Data

DES will operate co-located samplers at some of the sites to estimate the level of bias and precision being achieved in the field. These QA samplers within the FRM network provide a mechanism to evaluate precision and bias. The DQOs outlined in Element 7 state that for a three-year period, the concentrations measured by the FRM sampler must be within +/- 10% of the true concentration and that the CV of the relative differences between the co-located samplers must be less than 10%. These measures of precision and bias must be attained so that decision makers can make confident judgements about the New Hampshire's PM attainment/non-attainment status defined by the PM2.5 NAAQS. If a sampler is operating within the required bias and precision level, then the decision maker can proceed with the understanding that the decisions made will be supported by unambiguous data. If, however, a sampler exceeds either the bias and/or the precision limits, then the decision maker can not use the data to make decisions at a desired confidence level, and corrective action(s) must be implemented to ensure that future data that are collected from the sampler meet precision and bias limits.

According to *40 CFR Part 58, Volume 67, No. 251*, for each method designation, at least 15%

(minimum of one) of the samplers must be co-located. As a result, DES operates two co-located sites, Manchester and Laconia (see Table 10.1). Based on the PM2.5 data collected to date, none of the New Hampshire sites will exceed the NAAQS for PM2.5. The PM2.5 data is reviewed annually and DES will place the co-located samplers at the sites that are likely to have the highest concentrations of PM2.5. DES operates the two co-located samplers on a six-day sampling schedule, and coincides with the sampling run time of the primary site sampler so that the primary and co-located samplers are operating on the same days, at the same time.

10.3 Co-location with PM10

DES operates three sites that have both FRM PM2.5 samplers and FRM PM10 samplers - Portsmouth, Manchester and Keene. See Table 10.1 for more detail related to co-location. In general, over the last few years, DES PM10 network has been consolidated to these three sites over the last few years due to priority monitoring shifts at the national and state level.

10.4 Co-location with TEOM

Although not considered an FRM method, the TEOM continuous PM2.5 sampler gives decision makers important real-time PM2.5 data. Filter based samplers, such as the FRM PM2.5 samplers, offer no real-time information. Real-time data is essential to modelers and meteorologists trying to predict unhealthy air quality events and enact protective warnings.

Unfortunately, continuous analyzers do not always give true FRM type readings so it is important to co-locate these two types of samplers in order to develop a correlation and respected conversion factor for the TEOM. For real-time mapping and protective forecasting, the TEOM data should be converted into FRM like data.

DES operates four sites that have both FRM PM2.5 samplers and TEOM continuous PM2.5 samplers.

ELEMENT 11 – Sampling Methods Requirements

The PM2.5 samplers that DES uses in the PM2.5 sampling Program are of two types, Anderson RAAS 2.5 FRM and BGI Inc. PQ200 FRM samplers. DES deployed these samplers based on the Agency-approved network design plan. The two sampler types operate on the same principle and gather the same environmental sampling information. However, there are differences between the two types of samplers. The PQ200 is a single filter, manual load unit capable of running only one filter between site visits by the operator. The PQ200 is the primary PM2.5 sampler in DES network. The RAAS is an automated sequential sampler capable of holding multiple filters and mechanically collecting them in sequence in accordance with an operator programmed schedule. The RAAS 2.5 sampler is only used as a back up sampler in DES network. DES operates all PM 2.5 samplers in accordance with the Standard Operating Procedures (PM 2.5), Appendix E.

11.1 Field Work

The site operator services the PM 2.5 samplers shortly after a sample run. The longest period of time a sample filter can remain in a sampler, after collection, is 177 hours. When servicing a PM2.5 sampler the operator unloads the sample filter, collects the electronic 5-minute data (on data transfer devices), reloads a new filter and programs the sampler for the next run. The operator also processes any additional filters, field blanks and trip blanks, fills out the appropriate field forms, and performs scheduled preventive maintenance and QA checks while at the site. Back at the main offices in Concord, the operator initiates downloading of the 5-minute data from the data transfer device to the main computer drive.

11.2 5-Minute Data

Site operators capture the 5-minute electronic data from the samplers on data transfer devices (widgets) as described above. Back at the main office the operator gives the widgets to the Chief Technician or a designated Technician II who uploads the widget data to DES mainframe system. At this point the Chief Technician uses the 5-minute data to assess sampler performance and check QA of the sample.

11.3 Support Facilities and Sampling Methods

Primary coordination of the PM2.5 Monitoring Program takes place at the Divisional offices in Concord, New Hampshire with some aspects of the program being supported from other locations, on occasion. DES uses a variety of equipment, supplies and facilities while operating the PM2.5 Monitoring Program. Table 11.1 lists the facilities that DES uses in the program, the function that the facility serves and the support element that each facility provides. Table 11.2 lists the supplies that DES keeps for the program. Table 11.3 lists field operation and

maintenance items that DES issues to each operator.

Table 11.1 - Support Facilities for the PM2.5 Monitoring Program		
LOCATION	FUNCTION	INVOLVING
Department Office, Headquarters, Concord	Program Management	Logistics, Sites, Equipment
	Scheduling	Filters, QA/QC, Maintenance
	Filter Tracking	Distribution, Recovery, Archive
	Pre-Sample Distribution	Sampler Specific Assignments
	Post-Sample Transport	Collection for Delivery to Laboratory for Post-Sample Weighing
	Data Validation	Post Weighing Quality Assurance and Final Data Assessment
	Data Reporting	Data Entry to AIRS
Site Operator Vehicles	Operating Schedules	Calendars, Forms, Filters
	Site Service Supplies	Tools, Cleaning Supplies
	Filter Transport Supplies	Cooler, Thermometers, Blue Ice, Filter Canisters, Filter Holder Caps
	QA Check Equipment	Delta-Cal
Intermediate Laboratory	Temporary Storage	Walk-In Cooler for Temporary Storage of Filters While Awaiting Transport to Weighing Lab.
Weighing Laboratory (RTI)	Pre-Sample Filter Prep.	Filter Integrity Evaluation and Filter Conditioning
	Filter Weighing	Pre and Post Sample Determination of Filter Weight Using a Microbalance
	Post-Sample Filter Prep.	Filter Conditioning
	Filter Archival	Temperature Controlled Storage (1 Yr.)

Table 11.2 - Supplies at Storage Facilities		
Item	**Minimum Quantity**	**Notes**
Powder Free Gloves	box	*Material must be inert and static resistant*
Fuses	2	*Of the type specified in the sampler manual*
Temperature standard	3	*In the range expected for this site and NIST traceable*
Flow rate standard	3	*Calibrated from at least 15.0 LPM to 18.4 LPM and NIST Traceable*
Sampler Operations Manual	1 per model	
$PM_{2.5}$ Sampling SOP	3	
Flow rate verification filter	3	
Non-Permeable Membrane	3	*Contained in sampling cassette*
Filter Cassettes	3	*For use with flow rate check filter or non-permeable membrane*
Cleaning Wipes	1 Box	*Dust resistant*
Data Download Cable	1	*For use with laptop computer*

Table 11.3 – Site Operator Field Equipment	
ITEM	**FUNCTION**
Alcohol Lab Wipes	Cleaning of sample contact surfaces/WINS Impactor
Blue Ice	Provide cooling for filter transport containers
Bristle Brush	Cleaning sampler interiors
Clean Impactor Well	Replacement
Widgets	Sampler data transfer to central computer for evaluation
Filter Transport Canister	Hold and protect from filters from contamination during transport
Filter End Caps	Protect filter integrity with filters in cassettes
Forms	Recording sampler operational parameters

Insulated Cooler	Sample transport <39 C.
Min/Max Thermometer	Temperature tracking in sample transport coolers
Rubber Gloves	Prevent contamination of samples
Site Log Books	Documentation of site conditions and sampler operation
Vacuum Cleaner	Cleaning sampler interiors

*In addition, site operators should also carry copies of the appropriate Filter Forms, Chain of Custody Forms, and Field Forms to be filled out while at the site.

11.4 Sampling/Measurement System Corrective Action

DES takes corrective action measures in the PM2.5 Monitoring Program to ensure attainment of the data quality objectives. Within the program there is the potential for many types of sampling and measurement system corrective actions. Table 11.4 presents expected problems and details potential corrective actions needed for each problem.

Table 11.4 - Field Corrective Action

Item	Problem	Action	Notification
Filter Inspection (Pre-sample)	Pinhole(s) or torn	1.) If additional filters have been brought, use one of them. Void filter with pinhole or tear. 2.) Use new field blank filter as sample filter. 3.) Obtain a new filter from lab.	1.) Document on field data sheet. 2.) Document on field data sheet. 3.) Notify Field Manager
Filter Inspection (Post-sample)	Torn or otherwise suspect particulate by-passing 46.2 mm filter.	1.) Inspect area downstream of where filter rests in sampler and determine if particulate has been by-passing filter. 2.) Inspect in-line filter before sample pump and determine if excessive loading has occurred. Replace as necessary.	1.) Document on field data sheet. 2.) Document in log book.
WINS Impactor	Heavily loaded with course particulate. Will be obvious due to a "cone" shape on the impactor well.	Clean downtube and WINS impactor. Load new impactor oil in WINS impactor well	Document in log book
Sample Flow Rate Verification	Out of Specification (+ 4% of transfer standard)	1.) Completely remove flow rate device, re-connect and re-perform flow rate check. 2.) Perform leak test. 3.) Check flow rate at 3 points (15.0 LPM, 16.7 LPM, and 18.3 LPM) to determine if flow rate problem is with	1.) Document on data sheet. 2.) Document on data sheet. 3.) Document on data sheet. Notify Field Manager

Table 11.4 - Field Corrective Action			
Item	**Problem**	**Action**	**Notification**
		zero bias or slope. 4.) Re-calibrate flow rate	 4.) Document on data sheet. Notify Field Manager.
Leak Test	Leak outside acceptable tolerance (80 mL/min)	1.) Completely remove flow rate device, re-connect and re-perform leak test. 2.) Inspect all seals and O-rings, replace as necessary and re-perform leak test. 3.) Check sampler with different leak test device.	1.) Document in log book. 2.) Document in log book, notify Field Manager, and flag data since last successful leak test. 3.) Document in log book and notify Field Manager.
Sample Flow Rate	Consistently low flows documented during sample run	1.) Check programming of sampler flowrate. 2.) Check flow with a flow rate verification filter and determine if actual flow is low. 3.) Inspect in-line filter downstream of 46.2 mm filter location, replace as necessary.	1.) Document in log book. 2.) Document in log book. 3.) Document in log book.
Ambient Temperature Verification, and Filter Temperature Verification.	Out of Specification (+ 4°C of standard)	1.) Make certain thermocouples are immersed in same liquid at same point without touching sides or bottom of container. 2.) Use ice bath or warm water bath to check a different temperature. If acceptable, re-perform ambient temperature verification. 3.) Connect new thermocouple. 4.) Check ambient temperature with another NIST traceable thermometer.	1.) Document on data sheet. 2.) Document on data sheet. 3.) Document on data sheet. Notify Field Manager. 4.) Document on data sheet. Notify Field Manager.
Ambient Pressure Verification	Out of Specification (±10 mm Hg)	1.) Make certain pressure sensors are each exposed to the ambient air and are not in direct sunlight. 2.) Call local Airport or other source of ambient pressure data and compare that pressure to pressure data from monitors sensor. Pressure correction may be required 3.) Connect new pressure sensor	1.) Document on data sheet. 2.) Document on data sheet. 3.) Document on data sheet. Notify Field Manager
Elapsed Sample Time	Out of Specification (1 min/mo)	Check Programming, Verify Power Outages	Notify Field Manager
Elapsed Sample	Sample did not run	1.) Check Programming	1.) Document on data sheet.

Table 11.4 - Field Corrective Action			
Item	**Problem**	**Action**	**Notification**
Time		2.) Try programming sample run to start while operator is at site. Use a flow verification filter.	Notify Field Manager 2.) Document in log book. Notify Field Manager.
Power	Power Interruptions	Check Line Voltage	Notify Field Manager
Power	LCD panel on, but sample not working.	Check circuit breaker, some samplers have battery back-up for data but will not work without AC power.	Document in log book
Data Downloading	Data will not transfer to laptop computer	Document key information on sample data sheet. Make certain problem is resolved before data is written over in sampler microprocessor.	Notify Field Manager.

11.5 Sampling Equipment, Preservation, and Holding Time Requirements

This section discusses the requirements needed to prevent sample contamination, the volume of air to be sampled, how to protect the sample from contamination, temperature preservation requirements, and the permissible holding times to ensure against degradation of sample integrity.

11.5.1 Sample Contamination Prevention

The PM2.5 network has rigid requirements for preventing sample contamination. DES keeps all PM2.5 filters in protective filter cassettes. Operators use powder free gloves while handling filter cassettes and never open the filter cassettes until immediately before putting the filter on the sampler or immediately before taking the filter off the sampler. DES stores filter cassettes in filter cassette storage containers as provided by the sampler manufacturer during transport to and from the laboratory.

11.5.2 Sample Volume

Requires sampler flow rate is 16.67 L/min. Based on this flow rate the sampler will filter 24 cubic meters of air in the required 24 hour sample time. Federal regulations require that samples run for 24 hours; however, in some cases a shorter (or longer) sample period may be acceptable, not to be less than 23 hours (or greater than 25 hours). If a sample period is less than 23 hours or greater than 25 hours, DES will invalidate the sample and notify the QA Supervisor.

11.5.3 Temperature Preservation Requirements

During transport from the weigh room to the sample location there are no specific requirements for temperature control; however, DES does keep filters in the filter cassettes and in protective filter cassette containers while awaiting use. DES keeps filter away from excessive heat prior to use (e.g.,. does not leave in direct sunlight or a closed-up car during summer). Table 11.5 details the regulated filter temperature requirements.

Table 11.5 - Filter Temperature Requirements

Item	Temperature Requirement	Reference
Filter temperature control during sampling and until recovery.	No more than 5^{O} C above ambient temperature.	40 CFR Part 50, Appendix L, Section 7.4.10
Filter temperature control from time of recovery to start of conditioning.	Protected from exposure to temperatures over 25^{O} C.	40 CFR Part 50, Appendix L, Section 10.13
Post sample transport so that final weight may be determined up to 30 days after end of sample period.	4^{O} C or less	40 CFR Part 50, Appendix L, Section 8.3.6

11.5.4 Permissible Holding Times

The permissible holding times for the PM2.5 samples are clearly detailed in both *40 CFR Part 50, Appendix L, and Section 2.12* of the U.S. EPA QA Handbook. These holding times are provided in Table 11.6.

Table 11.6 - Holding Times

Item	Holding Time	From:	To:	Reference
Pre-weighed Filter	≤30 days	Date of Pre-weigh	Date of Sample	40 CFR Part 50, Appendix L, Section 8.3.5
Recovery of Filter	≤177 hours	Completion of sample period	Time of sample recovery	40 CFR Part 50, Appendix L, Section 10.10
Transport of Filter	<24 Hours (ideally)	Time of recovery	Time placed in conditioning room	40 CFR Part 50, Appendix L, Section 10.13
Post Sample Filter stored at $<4^{o}$ C.	≤30 days	Sample end date/time	Date of Post Weigh	40 CFR Part 50, Appendix L, Section 8.3.6
Post Sample Filter continuously stored at $<25^{o}$ C.	≤10 days	Sample end date/time	Date of Post Weigh	40 CFR Part 50, Appendix L, Section 8.3.6

Element 12 – Sample Handling and Custody Requirements

12.1 Sample Handling

DES and RTI handle all filters (samples) in accordance with the proper requirements and guidance found in the Appendices E and I of this PM2.5 QAPP.

12.1.1 Filter Preparation

RTI conducts pre-sample filter conditioning and pre-sample weighing for the PM2.5 Monitoring Program. When properly prepared, RTI places filters in cassettes, then places the filter cassettes in protective canisters. RTI numbers each filter and mails the "ready" filters to DES. At DES, an appointed Technician II prepares a list of filter numbers, assigns each filter to a site and run date, then distributes the filters to appropriate site operators. The site operators initiate the chain of custody forms, transport filter cassettes to the samplers under ambient temperature conditions, load the filter cassettes into the designated samplers, and set up run times and filter tracking sheets. DES, by regulation, uses prepared filters prior to 30-days after the initial weighing carried out by RTI.

12.1.2 Post Sample Filter Handling

Operators remove sample filter cassettes from samplers within 177 hours of the end of the sample run, place filter cassettes with the sample side upright, within filter transport containers, and transport the sample with the sample side upright at 39 ^{o}F or less using Igloo coolers and blue ice with digital Min/Max thermometers for temperature tracking. The operators transport the filters to the DES offices in Concord where the filters are kept refrigerated at 39 ^{o}F or less. Weekly on Thursdays, an appointed Technician II packages sample filters in a Styrofoam lined box, with numerous blue ice packs and sends the filters to RTI, via overnight express mail, for analysis. The transfer of filters from sampler to the weighing laboratory occurs within 10 days or less. DES transfers chain of custody to RTI by placing Filter Logsheets with the filters. DES has designed the Filter Logsheets to be chain of custody forms (Appendix B) to track the filters throughout the preparation, sample and post sample weighing process.

12.1.3 Filter Archiving

Upon completion of filter weighing, RTI archives DES filters according to proper laboratory filter archiving practices. All filters from the fine particle sampling program will be archived for one year in accordance with the requirements of Appendix I.

Table 12.1 and Table 12.2 outline the time and temperature requirements with respect to filter handling in DES' PM2.5 Monitoring Program. An example of the filter archiving form is

presented in Appendix B.

12.1.4 Sample Custody

DES uses Filter Logsheets to document the assigned sampling location for each filter. Filter Logsheets originate at DES main offices in Concord and follow the filter until it is returned to RTI for post sample weighing. Site operators initial sign-off boxes on the Filter Logsheets indicating that they have been responsible for the filters in the field. RTI forwards laboratory forms to DES for review and archiving. Examples of various forms used for tracking and archiving the filters are included in Appendix B.

One of the most important values in the sample custody procedure is the unique filter ID number, illustrated below. The filter ID is an alpha-numeric value. The initial two alpha values identify the type of filter as being either a routine filter (RF), a field blank (FB), a lab blank (LB) or a flow check filter (FC) used for the flow rate check. The next two values (YY) represent the last two digits of the calendar year and the next 4 digits represent a unique number. Each combination of filter type and year will start with the value 0001. Therefore, for 1998 the first routine filter will be numbered RF980001 and the field blank will be FB980001. The filter ID will be generated by RTI at the time of pre-weighing.

Filter ID

A	A	Y	Y	X	X	X	X
Filter Type		---Year---		----Unique number-----			

Table 12.1 – Filter Holding Times

Item	Holding Time	From:	To:
Pre-Weighed Filter	≤ 30 Days	Date of Initial Filter Weighing	Date of Sample
Collection of Filter	≤ 177 Hours	Completion of Sample Period	Time of Sample Recovery
Transport of Filter	< 8 Hours	Time of Removal from Sampler	Time Filter Arrives at Interim Laboratory
Interim Storage < 4°C.	< 10 Days	Time in/Time out	Arrival to Departure
Transport of Filter	< 24 Hours	Interim Storage	Conditioning Room

Post Sample Filter Storage < 4°C.	≤ 30 Days	Collection of Sample	Date of Post Sample Weighing
Post Sample Filter Storage < 25°C.	≤ 10 Days	Collection of Sample	Date of Post Sample Weighing

Table 12.2 – Filter Temperature Requirements

ITEM	TEMPERATURE REQUIREMENT
Filter Temperature After Initial Weighing Before Installation In Sampler	Filter Must Be Protected From Excessive Temperatures
Filter Temperature During Sampling until Recovery from Sampler	No More Than 5°C. Above Ambient Temperature
Filter Temperature Requirements During Transport	Filter Must Be Protected From Temperatures Greater Than 25°C.
To Extend The Time Allowed For Post Sample Weighing	Filter Must Be Transported and Stored at Temperatures Less Than 4°C.

12.2 Filter Receipt Procedures

RTI pre-weighs filters on Tuesdays, sends them on Wednesdays and DES receives the filters on Thursdays or Fridays. RTI currently sends 25 filters per shipment, but charges DES for 26 filters because one of the filters is a lab blank, which remains in the lab at RTI. DES receives the shipments of filters by Thursday or Friday from the shipping department at 29 Hazen Drive in Concord. DES personnel from the shipping department delivers the filters to an appointed Technician II of the Air Monitoring Program.

The appointed Technician II will open and process the filters in accordance with the following procedure:

1). Pull off tracking sticker on box so it can be returned to the shipping department for their records. Put on sticky paper with note where it comes from and return to shipping department.
2). Remove Chain of Custody form with all the information pertaining to the filters received (see Appedix B for a image of this form).

3). Sign the Custody form and put in 2.5 logbooks for tracking.
4). Put filters in refrigerator until they are logged in.
5). Log the Filters into the database and assigned to each to a site in the Filter Inventory Log Sheet (See Appendix B).

12.3 Filter Shipping Procedures

DES sends PM2.5 filters by UPS every Thursday. The packaged filters must be in the shipping area by 2:00 pm every Thursday.

DES must maintain the temperature of these filters at 4 ^{0}C or below. If for some reason the filters do not go out on Thursday, someone will have to let Normajean Smith (0911), Jim Poisson (7502) or Kendall Perkins (1384) in Air Monitoring know about it A.S.A.P.. If this happens, filters need to be taken out of the box and stored in the refrigerator in the Air Monitoring section (under Norma's desk) until the next available shipping day, (Monday) then repacked with fresh ice packs. Never send filters out on Fridays!!

DES pays filter shipping fees out of account 9025 (unless otherwise noted).

DES packs filters in a pre-supplied Styrofoam box surrounded by ice packs. DES stores the ice packs in the freezer in the 2nd Floor West lunchroom. No food contamination is allowed in the freezer with the ice packs.

Packaging instructions for Air Monitoring personnel:

1.) Pack the filters in box with ice packs (as much as you can fit) and cover with top lid. Fold a Filter Logsheet (see Appendix B) identifying the filters that are sent to RTI and lay it on top of Styrofoam lid.
2.) Tape up box
3.) Put note on box that it goes to RTI (labels are pre-made in shipping) with the account number incase someone new is doing the shipping.
4.) Bring box down to shipping and leave in appropriate area. Ensure Package gets underway on Thursday.

Element 13 - Analytical Methods Requirements

13.1 Introduction

DES does not operate a PM2.5 weighing facility. Rather, DES subcontracts all analytical PM2.5 work to RTI. RTI has step-by-step protocols for receiving filters, storing filters, conditioning filters, weighing filters, and preparing all documentation. RTI methods include all appropriate QA/QC procedures and responsibilities to ensure quality data.

13.2 Filter Sample Contamination Prevention, Preservation, and Holding Time Requirements

This section details the requirements needed to prevent and protect the filter sample from contamination, the volume of air to be sampled, temperature preservation requirements, and the permissible holding times to ensure against degradation of sample integrity.

13.2.1 Sample Volume.

As per *40 CFR Part 50*, Sample flow rate of air is 16.67 L/min. Total sample of air collected is 24 cubic meters based upon a 24 hour sample.

13.2.2 Temperature Preservation Requirements.

The temperature requirements of the PM2.5 network are explicitly detailed in Element 11 of this QAPP and *40 CFR Part 50*. At RTI, within the weigh room laboratory, all filters are conditioned for a minimum of 24 hours prior to pre-weighing. RTI maintains the weigh room laboratory temperature between 20 and 23^{O} C, with no more than a +/- 2^{O} C change over the 24 period prior to weighing the filters.

The specifics of temperature preservation requirements are clearly detailed in *40 CFR Part 50, Appendix L* and Element 12 of this QAPP. These requirements pertain to both sample media before collection and both the sample media and sample after a sample has been collected. Additionally, during the sample collection there are requirements for temperature control, which the DES maintains. Table 13.1 details these temperature requirements.

Table 13.1 – More Temperature Requirements

Item	Temperature Requirement	Reference
Weigh Room	20 - 23^{O} C	40 CFR Part 50, Appendix L, Section 8.3.1
Pre-weighed Filter	+/- 2^{O} C for 24 hours prior to weighing	40 CFR Part 50, Appendix L, Section 8.3.2

Filter Temperature Control during sampling and until recovery	*No more than 5^{O} C above ambient temperature.*	*40 CFR Part 50, Appendix L, Section 7.4.10*
Post Sample Transport so that final weight may be determined up to 30 days after end of sample period	4^{O} C or less	40 CFR Part 50, Appendix L, Section 8.3.6

13.2.3 Permissible Holding Times

The permissible holding times for the $PM_{2.5}$ sample are clearly detailed in both *40 CFR Part 50* and *Section 2.12 of the U.S. EPA QA Handbook*. A summary of these holding times are provided in the Sampling Methods Requirements, Element 11 of this QAPP.

Element 14 – Quality Control Requirements

14.1 Introduction

DES implements a comprehensive QA/QC program with the PM 2.5 Monitoring Program network. In doing so DES follows the quality assurance requirements in *40 CFR Part 58, Appendix A*, *40 CFR Part 50, Appendix L* and in the *Quality Assurance Guidance Document 2.12, Section 10*. Table 14.1 and Table 14.2 list the QC checks that DES carries out in the field and in the laboratory. These Tables list the frequency of the checks, acceptance criteria for the checks, references for the requirement and the information provided by the check. Figure 14.1 provides a schematic of the kinds of QC activities that DES employs to ensure good QC in the PM2.5 Monitoring Program.

DES documents all QA/QC checks at the level at which the check is performed. Site operators routinely log any deficiencies in sampler operation or any condition that may affect sample integrity. Site operators also note leak checks, temperature probe, pressure sensor and flow checks and any other QC work in the site log book. The Electronic Technician will conduct unscheduled sampler maintenance in a timely manner, and will document the work in the site log and in the repair technician's daily activity record. A delegated Technician II will track equipment in a database by location and manufacturer's serial number. AMP personnel who become aware of any condition that could compromise the quality of data produced by the sampler report that information to the Chief Air Pollution Technician who ensures that corrective action is taken. The Program Manager evaluates any samples collected during the period of time that the sampler was operating outside of specifications for validity and the data if needed. The filter handling laboratory, RTI, implements a comprehensive QA/QC program in conformance with all applicable regulations and guidance to insure that all required filter handling and weighing conditions are met and documented and to preserve the integrity of the data. Lisa Greene, of RTI, is responsible for laboratory operations relative to the PM2.5 Monitoring Program.

DES employs a number of different methods of checking, evaluating and comparing sample collection systems, filter handling procedures, weighing apparatus and data calculation and reporting procedures. Table 12.1 includes techniques/procedures that DES uses to evaluate the PM2.5 data.

Table 14.1 QC Checks

Requirement	Frequency	Acceptance Criteria	CFR Reference	2.12 Reference	Information Provided
Calibration Standards					
Flow Rate Transfer Std.	1/yr	±2% of NIST-traceable Std.	Part 50, App.L Sec 9.1, 9.2	Sec. 6.3	Certification of Traceability
Field Thermometer	1/yr	± 0.1° C resolution	not described	Sec 4.2 and 8.3	Certification of Traceability
		± 0.5° C accuracy	not described	"	
Field Barometer	1/yr	± 1 mm Hg resolution	not described	"	Certification of Traceability
		± 5 mm Hg accuracy	not described	"	
Calibration/Verification					
Flow Rate (FR) Calibration	If multi-point failure	± 2% of transfer standard	Part 50, App.L, Sec 9.2	Sec 6.3 and 6.6	Calibration drift and memory effects
FR multi-point verfification	1/yr	± 2% of transfer standard	Part 50, App.L, Sec 9.2.5	Sec 8.3	Calibration drift and memory effects
One point FR verification	1/4 weeks	± 4% of transfer standard		Sec 8.3	Calibration drift and memory effects
External Leak Check	every 5 sampling events	80 mL/min	Part 50, App.L, Sec 7.4	Sec. 8.3	Sampler function
Internal Leak Check	every 5 sampling events	80 mL/min	"	Sec. 8.3	Sampler function
Temperature Calibration	If multi-point failure	± 2% of standard	Part 50, App.L, Sec 9.3	Sec. 6.4	Calibration drift and memory effects
Temp multi-point verification	on installation, then 1/yr	± 2°C of standard	Part 50, App.L, Sec 9.3	Sec. 6.4 and 8.2	Calibration drift and memory effects
One- point temp Verification	1/4 weeks	± 4°C of standard	"	Sec. 6.4 and 8.2	Calibration drift and memory effects
Pressure Calibration	on installation, then 1/yr 1/4	±10 mm Hg	"	Sec. 6.5	Calibration drift and memory effects
Pressure Verification	weeks	±10 mm Hg	"	Sec. 8.2	Calibration drift and memory effects
Clock/timer Verification	1/ 4 weeks	1 min/mo	Part 50, App.L, Sec 7.4	not described	Verification of to assure proper function
Blanks					
Field Blanks	See 2.12 reference	±30 µg	Part 50, App.L Sec 8.2	Sec. 7.10	Measurement system contamination
Precision Checks					
Collocated samples	every 6 days	CV ≤ 10%	Part 58, App.A, Sec 3.5, 5.5	Sec. 10.3	Measurement system precision
Accuracy					
Flow rate audit	1/3mo (manual)	± 4% of transfer standard	Part 58, App A, Sec 3.5.1	Sec. 8.1	Instrument bias/accuracy
External Leak Check	4/yr	< 80 mL/min	not described	"	Sampler function
Internal Leak Check	4/yr	< 80 mL/min	not described	"	Sampler function
Temperature Check	4/yr	± 2°C	not described	"	Calibration drift and memory effects
Pressure Check	4/yr (?)	±10 mm Hg		"	Calibration drift and memory effects
Audits (*external assessments*)					
FRM Performance evaluation	25% of sites 4/yr	± 10%	Part 58, App A, Sec 3.5.3	Sec 10.3	Measurement system bias
Flow rate audit	1/yr	± 4% of audit standard	not described	Sec 10.2	External verification bias/accuracy
External Leak Check	1/yr	< 80 mL/min	not described		Sampler function
Internal Leak Check	1/yr	< 80 mL/min	not described		Sampler function
Temperature Audit	1/yr	± 2°C	not described		Calibration drift and memory effects
Pressure Audit	1/yr	±10 mm Hg	not described		Calibration drift and memory effects

14.2 Calibrations

Calibration is the comparison of a measurement standard or instrument with another standard or instrument to report, or eliminate by adjustment, any variation (deviation) in the accuracy of the instrument being compared.

In very general terms, DES follows a two step process for calibration activities. First, DES certifies the calibration standard and/or transfer standard against an authoritative standard, and then DES compares the calibration standard and/or transfer standard against the routine sampling/analytical instruments.

Calibration requirements for critical field and laboratory equipment are found in Tables 14.1 and 14.2 respectively; the details of the calibration methods are included in the calibration section (Element 16 of this QAPP).

14.3 Blanks

DES, EPA and RTI use blank samples to determine contamination arising from principally four sources: the environment from which the sample was collected/analyzed, the reagents used in the analysis, the apparatus used, and the operator/analyst performing the data operation. DES, EPA and RTI utilizes three types of blanks in the PM2.5 Monitoring Program:

14.3.1 Lot Blanks

EPA, through a contractor, periodically ships 46.2mm filters to RTI. EPA must test each shipment and determine filter acceptability.

14.3.2 Field Blanks

Field blanks provide an estimate of total measurement system contamination. By comparing information from laboratory blanks against the field blanks, one can assess contamination from field activities. Details about DES' use of field blanks can be found in field SOPs (Appendix E)

14.3.3 Lab Blanks

Laboratory blanks provide an estimate of contamination occurring at the weighing facility. Details about RTI's use of laboratory blanks can be found in RTI's SOPs.

14.4 Precision Checks

Precision is the measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. In order to meet the data quality objectives for precision, DES must ensure the entire measurement process is within statistical

control. DES uses co-located monitoring to assess precision in the PM2.5 Monitoring Program.

14.5 Co-located Monitoring

In order to evaluate total measurement precision, DES is co-locating PM2.5 analyzers at 20% of the PM2.5 sites, in accordance with federal requirements. DES always considers the first co-located sampler as the FRM sampler. If one of the samplers does not run, for any reason, during a scheduled co-located event, then DES will use the good sample as FRM data for the site.

DES selects co-located measurement pairs for use in the precision calculations only when both measurements are above 6µg/m^3. However, DES reports all collocated data to AIRS. The algorithms will be used to evaluate collocated data. DES will evaluate the CV as explained in Element 19 of this QAPP to ensure a 10% CV objective is being achieved.

14.6 Accuracy or Bias Checks

Accuracy is defined as the degree of agreement between an observed value and an accepted reference value and includes a combination of random error (precision) and systematic error (bias). DES uses flow rate audits and third party performance evaluations to assess accuracy and bias in the PM2.5 Monitoring Program.

Although collocated monitors are primarily used for evaluating and controlling precision, they can also be used to determine accuracy or bias. One can track trends between the two instruments without knowing which instrument is producing the "true" value. Use of the FRM performance evaluation information (discussed below) in conjunction with collocation data should help improve the quality of data.

14.6.1 Audits

DES conducts audits on all active PM2.5 at least once a quarter. Details of the implementation aspects of the audit are included in Element 11. DES conducts the audit by measuring the analyzer's normal operating flow rate using a certified flow rate transfer standard, Delta Cal device manufactured by BGI Inc. The Delta Cal standard used for auditing is not be the same Delta Cal used to calibrate the analyzer. However, both the calibration standard and the audit standard may be referenced to the same primary flow rate or volume standard. DES reports both the audit (actual) flow rate and the corresponding flow rate indicated or assumed by the sampler. DES uses procedures detailed in *40 CFR Part 58 Appendix A* to calculate measurement uncertainty. These methods will be used by DES and the results of the calculations will be reported to the AIRS, as required.

14.6.2 FRM Performance Evaluation

The FRM Performance Evaluation Program (PEP) is a quality assurance activity which will be

used to provide additional measurements of systems bias within the PM2.5 network. The pertinent regulations for this performance evaluation are found in *40 CFR Part 58, Appendix A, Section 5.3*. The strategy is to co-locate a portable FRM PM2.5 air sampling instrument with an established routine air monitoring site, operate both monitors in exactly the same manner, and then compare the results of this instrument against the routine sampler at the site. The EPA Region I will be implementing this program and will inform DES when an evaluation will be conducted. The evaluation will be conducted on a regularly scheduled sampling day and the filters from the evaluation instrument will be sent to a national laboratory in Region 10 for measurement. The comparison of data will be accomplished by EPA personnel using the AIRS data base. It must be noted that the performance evaluation is an estimate of the uncertainty of the measurement system and not the instrument. Therefore, any bias may be attributed to sample handling, transportation and laboratory activities as well as to the instrument. The statistics used in the assessment are included in *40 CFR part 58*.

Element 15 – Equipment Testing, Inspection and Maintenance

DES has established a comprehensive plan for the testing, inspecting and maintaining all PM2.5 samplers in the network in accordance with the guidelines of *40 CFR Part 50, Appendix L*. This plan includes peripheral equipment used to ensure the measurement accuracy of sampler sensors. The overall objective of this plan is to preserve the mechanical and electronic integrity of the FRM samplers and thus maintain the quality of data capture and reliability of the sampling system. Experience with the sampling equipment throughout the four seasons has defined the types and quantity of parts held in stock to ensure that sampler down time is minimized.

Site operators are responsible for the day-to-day operation of the fine particulate samplers on their respective routes. These individuals have responsibility for cleaning and maintaining the instrument and reporting any problems to the Chief Technician. The site operators carry out these activities in accordance with the sampler's instructions, and guidance written in the *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II*. Table 15.1 presents a list of inspection activities for the PM2.5 samplers. Table 15.2 presents a list of preventive maintenance activities for the PM2.5 samplers. Site operators record all PM2.5 sampler maintenance activities in the program tracking database at the main offices at Hazen Drive in Concord. The Electronic Technician carries out maintenance procedures requiring more extensive knowledge or equipment. The Electronic Technician documents all his maintenance in the program tracking database and on a electronic spreadsheet. When DES has to contact the equipment manufacturer and (or) return the samplers for repair, DES documents this activity in both the program database and in the electronic spreadsheet. The Chief Air Pollution Technician establishes routine maintenance schedules.

Table 15.1 - Inspection of Field Items

Item	Inspection Frequency	Inspection Parameter	Action if Item Fails Inspection	Documentation Requirement
Sample downtube	Every site visit	Visible particulate	Clean with a clean dry cloth	Document in log book
WINS Impactor well	Every site visit	"Cone" shape of particulate on impactor well	Replace impactor well (including new impactor oil)	Document in log book
Rain collector	Every site visit	>1/3 full	Empty	Document in log book
O-rings	Every site visit	Any damage	Replace	Document in logbook
Filter Cassettes	After each sample run	Visible particulate	Check downtube and WINS impactor	Document in log book

Table 15.1 - Inspection of Field Items				
Cassette Seals	Each sample	Clean and smooth	Clean with a clean dry cloth, or replace as needed	Document when replaced
Battery	Every 6 months	Decrease in voltage	Replace	Document in log book

Table 15.2 - Preventive Maintenance of Field Items		
Item	**Maintenance Frequency**	**Location Maintenance Performed**
Clean WINS $PM_{2.5}$ Impactor	Every 5 sample episodes	At DES Lab
PM 10 Inlet	Monthly	At Site
Filter Cassettes	Each run	At DES Lab
Air Screens (under samplers rain hood)	6 Months	At Site
Clean filter holding area, internal and external	Monthly	At Site
Sample Pump Rebuild	Every 10,000 hours of operation	At DES Lab

DES will not conduct inspections of the RTI weighing laboratory. However, RTI does keep DES apprised of any potential problems at the weighing laboratory that may influence the quality of the weighing activities at the laboratory. The Air Monitoring Program Manager subsequently reports to the Division Director on the status of the quality of information provided by the RTI Weighing Laboratory.

Element 16 – Instrument Calibration and Frequency

16.1 Introduction

DES has established a program of checking and verifying the proper operation of temperature, pressure and flow rate sensors on the instruments. DES ensures that the equipment used to carry out these checks is representative of the parameter being measured or compared, maintains the equipment in a laboratory environment when not in use, and periodically compares the equipment to NIST traceable standards. Staff members doing the checks will be trained in the correct procedures for doing the checks. The Chief Air Pollution Technician conducts scheduled supervised checks. The Program Manager conducts periodic reviews of all of the procedures and documentation.

Table 16.1 details the procedure, the time interval and the staff member responsible for performing instrument calibration activities.

Table 16.1 Required Instrument Calibration Activities

Requirement	Frequency	Acceptance Criteria	Personnel Performing This Function
Calibration Standards			
Flow Rate Transfer Std.	1/yr	±2% of NIST-traceable	Laboratory Scientist
Field Thermometer	1/yr	Std. ± 0.1° C resolution	Laboratory Scientist
Field Barometer	1/yr	± 0.5° C accuracy ± 1 mm Hg resolution ± 5 mm Hg accuracy	Laboratory Scientist
Calibration/Verification			
Flow Rate (FR) Calibration	If multi-point failure	± 2% of transfer standard	Air Pollution Technician II
FR multi-point verfification	1/yr	± 2% of transfer standard	Air Pollution Technician II
One point FR verification	1/4 weeks	± 4% of transfer standard	Site Operator
External Leak Check	every 5 sampling events	80 mL/min	Site Operator
Internal Leak Check	every 5 sampling events	80 mL/min	Site Operator
Temperature Calibration	If multi-point failure	± 2% of standard	Air Pollution Technician II
Temp multi-point verification	on installation, then 1/yr	± 2°C of standard	Air Pollution Technician II
One- point temp Verification	1/4 weeks	± 4°C of standard	Site Operator
Pressure Calibration	on installation, then 1/yr 1/4	±10 mm Hg	Air Pollution Technician II
Pressure Verification	weeks	±10 mm Hg	Air Pollution Technician II
Clock/timer Verification	1/ 4 weeks	1 min/mo	Site Operator
Blanks			
Field Blanks	See 2.12 reference	±30 µg	Site Operator
Precision Checks			
Collocated samples	every 6 days	CV ≤ 10%	Site Operator

DES follows the requirements of 40 CFR Part 50, Appendix L, Section 6.0 of the Quality Assurance Guidance Document 2.12 and applicable Standard Operating Procedures when using

the PM2.5 samplers in the network. Table 16.2 lists the field quality control procedures, the interval at which these procedures are done, and the entity responsible for carrying out the task.

Table 16.2 – Field Quality Control Schedule

ACTIVITY	DAILY	EVERY 5 SAMPLES	EVERY 15 SAMPLES	EVERY MONTH	EVERY 3 MONTHS	ANNUAL	RESPONSIBLE PARTY
ACCURACY: Field Checks							
External Leak Check		X					Operator
Internal Leak Check		X					Operator
Temperature Audit		X					Operator
Pressure Audit		X					Operator
Flow Rate Audit		X					Operator
External Leak Check					X		DES Audit
Internal Leak Check					X		DES Audit
Temperature Audit					X		DES Audit
Pressure Audit					X		DES Audit
Flow Rate Audit					X		DES Audit
Inspect & Grease O-Rings						X	Operator
Inspect & Service Weather Seal						X	Operator
Remove, Inspect and Service Impactor O-Rings						X	Operator
Inspect & Service Tubing, Fittings & Connections						X	Operator
Inspect & Service Sampler Cooling Fan & Filter						X	Operator
Perform Multi-Point Verification of Flow Rate, Pressure & Temperature Sensors						X	DES Auditor
Calibrate Laboratory Standards						X	Laboratory
Check Operation During Sampling Period	X						Operator DataGroup
Service Water Bottle		X					Operator

Service WINS Impactor		X					Operator
Clean Inlet and Downtube			X				Operator
Single Point Flow Rate Check				X			Operator
Single Point Temp. & Pressure Sensor Check				X			Operator
Clock/Timer Verification				X			Operator
Clean Filter Chamber				X			Operator
Clean Sampler Interior				X			Operator
Inspect O-rings & Gaskets				X			Operator
Clean Impactor Jet & Housing				X			Operator
Inspect Sample Transport Containers				X			Operator Lab

16.2 Field Calibration

QC personnel perform field calibrations on the PM2.5 samplers whenever the samplers fail a QC check, whenever the sampler is moved to a new location and annually. The Chief Technician, QA Supervisor and Electronic Technician are all authorized to conduct field calibrations on the PM2.5 samplers. They follow procedures outlined in the respected sampler manuals and in Appendix E of this QAPP.

Field Calibration procedures include calibration of the ambient air and filter temperature sensors, as well as flow and barometric pressure. The ambient air sensor is located inside the shielded fixture on the outside of the PM2.5 sampler and is easy to unfasten and remove for comparison to a transfer standard for temperature. The filter temperature sensor is located in the (open) space just below the filter cassette. It is threaded through the walls of the filter cassette holding assembly section of the sampler and removal of plastic or metal fittings is required to remove the sensor and its associated wiring. It may be difficult to calibrate this sensor in the field. DES always follows a field calibration with a leak check after reinstalling the filter temperature sensor. DES uses a BGI Delta-cal to perform field calibrations. The Delta-cal is NIST traceable relative to flow, temperature and barometric pressure.

16.3 Calibration Standard (Delta-cal)

DES uses a Delta-cal, manufactures by BGI Inc., for transferring flow, temperature and pressure NIST traceability to the PM2.5 samplers. The Delta-cal measures volumetric flow rate by utilizing a pressure transducer to measure the pressure drop caused by air being drawn through a venturi. DES uses a primary Delta-cal unit to certify other Delta-cals used by DES personnel. The primary Delta-cal gets sent back to BGI Inc., annually for NIST certification. After the primary Delta-cal gets certified, an appointed Technician II will transfer this certification to the other Delta-cals used in the network. The SOP's for transferring the Delta-cal traceability to other Delta-cals are in Appendix E of this QAPP. The Form DES uses to transfer NIST traceability from the primary Delta-cal to the other Delta-cals in the network can be found in Appendix B of this QAPP.

16.4 Calibration Frequency

Table 16.1 summarizes field QC checks and related frequency and acceptance criteria. The field sampler flow rate, temperature and pressure sensor verification checks include 1-point checks at least monthly and multipoint checks (calibration without adjustment unless needed as determined independently and then performed by the vendor's authorized service representative) at least annually.

DES documents all of these events, as well as sampler and calibration equipment maintenance in field data records and notebooks. Laboratory and field activities associated with equipment used by the respective technical staff will be kept in record notebooks as well.

Forms associated with PM2.5 sampler calibrations and audits can be found in Appendix B of this QAPP.

Element 17 – Inspection/Acceptance Requirements for Supplies and Consumables

17.1 Introduction

DES' PM2.5 network relies on various supplies and consumables that are critical to its operation. When these items come in to the main office at Hazen Drive in Concord, an appointed Air Monitoring Program person will determine if the items are of acceptable specification for their intended purpose. DES bases acceptance criteria on the requirements of the regulations and guidance, and the requirements of the program. This section details the supplies/consumables, their acceptance criteria, and the required documentation for tracking this process.

Examples of acceptance criteria include:

1. Is the item received at DES the same item that was ordered or specified?

2. Does the item meet the requirements of the PM2.5 Monitoring Program?

3. Are the supplies compatible with other supplies used in the program?

If DES receives items that do not meet the specifications described at the time of the order, DES will return the item to the vendor and pursue acquisition of the acceptable version of the item. Appendix E has additional information concerning shipping and receiving of consumable and non-consumable items. Table 17.1 presents a list of critical supplies and consumables.

Table 17.1 - Critical Supplies and Consumables

Area	Item	Description	Vendor	Model Number
Sampler	Impactor Oil	Tetramethyltetraphenyl-trisiloxane (30ml)	Dow Corning@	704 Oil
Sampler	37 mm Glass Fiber Filter	For use in impactor well	*Andersen/BGI*	*950-3110*
Sampler	Rain Collector	Glass	*Andersen/BGI*	
Sampler	O-Rings	The O-rings that seal in the filter cassette when it is placed in the sampler.	*Andersen/BGI*	*RAAS-OR2*
Sampler	In-line Filter	Downstream of sample collection and upstream of sample pump.	*Andersen/BGI*	*RAAS-AF*
Sampler	Battery	Internal Sampler Battery.	Purchase local	*9 Volt*

Table 17.1 - Critical Supplies and Consumables				
Area	**Item**	**Description**	**Vendor**	**Model Number**
Sampler	Fuses	In sampler	Purchase local	*Buss*
Sampler	Floppy Disks	3.5" Pre-formatted	Purchase local	Var
Filter	Filters	46.2 mm teflon	Whatman@	
Filter	Petri-dish	47 mm with securing ring.	Gelman@	7231
Filter	Filter Cassettes (single)	As per CFR design	*Andersen/BGI*	*RAAS-CASS*
Filter	Filter Cassette Holder, Protective Containers	For securing cassette	*Andersen/BGI*	*RAAS-TC2*
Filter	Sequential Sampler Cassette Holder	For use with *RAAS2.5-300*	*Andersen/BGI*	*4400-011*
Filter	Filter Handling Containers	For transport to and from the field	*Igloo*	*Var*
Weigh Room*	Staticide	Anti-static solution	Cole-Parmer@	E-33672-00
Weigh Room*	Static Control Strips	Polonium 500μC_i	Mettler-Toledo@	110653
Weigh Room*	Air Filters	High Efficiency	Purchase Local	Var
All*	Powder Free Antistatic Gloves	Vinyl, Class M4.5	Fisher Scientific@	Small 11-393-85A Medium 11-393-85A Large 11-393-85A X-Large 11-393-85A
All*	Low-lint wipes	4.5" x 8.5" Cleaning Wipes	Kimwipes@	34155
* RTI is responsible for filter weighing laboratory supplies and filters while in their possession				

17.2 Acceptance criteria

Acceptance criteria must be consistent with the overall program technical and quality criteria. *40 CFR Part 50* specifies some acceptance criteria. DES enacts other acceptance criteria (such as physical damage due to shipping) once the equipment has arrived on site. Table 17.2 presents examples of acceptance tests and limits for procurement of supplies and consumables (lab and field) which may be used in the program.

Table 17.2 Acceptance Criteria for Supplies and Consumables		
Equipment	**Acceptance Criteria**	**Action if Requirements not met**
Impactor Oil	Is the oil identified as Tetramethyltetraphenyl-trisiloxane	Return
37 mm Glass Fiber Filter	Filters of the correct size and quality	Return
Rain Collector	Not broken	Call Vendor, will likely not return
O-Rings	Of the correct size	Return
In-line Filter	Of the correct size	Return
Battery	Correct size and voltage	Return
Fuses	Correct size and specification	Return
Floppy Disks	Undamaged and pre-formatted	Return
Filters, 46.2 mm Teflon	Tested and Accepted by the U.S. EPA with documentation of acceptance in package. Should meet visual inspection and pre-weight (110-160mg) criteria	Call David Lutz, U.S. EPA (919) 541-5476
Petri-dish	Clean and appropriately sized for 46.2 mm filters	Return
Filter Cassettes (single)	Of the correct type and make	Return
Filter Cassette Holder, Protective Containers	Of the correct size so that filter cassettes will not move around that could potentially lead to dislodging particulate	Return
Sequential Sampler Cassette Holder	Of the correct type for use with the sequential sampler model	Return
Filter Handling Containers	Clean	Clean
Anti-Static Solution	Of the correct type	Return
Static Control Strips	Manufactured within past 3 months and between 400 and 500μC_i of Polonium	Call vendor
Air Filters	Of the size and quality specified	Return
Powder Free Antistatic Gloves	Of the size and quality specified	Return

Table 17.2 Acceptance Criteria for Supplies and Consumables		
Equipment	**Acceptance Criteria**	**Action if Requirements not met**
Cleaning Wipes	Of the quality specified	Return

17.3 Tracking and Quality Verification

There are two main components to tracking and verifying the quality of incoming supplies/consumables/equipment. The first is the need for DES to verify receipt of an item in acceptable condition. The second need is for DES' purchasing department to accurately track goods received, and to pay the vendor. In order to address these two issues, DES uses the following tracking and documentation procedures whenever new supplies/consumables/equipment arrive at DES:

- Perform a rudimentary inspection of the package as soon as it is received from the courier or shipping company. Note any obvious problems with the contents of the shipment such as a crushed box or wet cardboard which could indicate damage to the contents.

- Open and inspect the contents compared with the packing slip and the original request for purchase.

- If there is a problem with the supply/consumable/equipment, note it on the packing list, notify the supervisor of the receiving area and immediately call the vendor.

- If the supply/consumable/equipment appears to be complete and in good condition, sign and date the packing list and send it to accounts payable so payment can be made in a timely manner.

- Notify appropriate personnel that supplies/consumables/equipment has arrived.

- Stock supplies/consumables/equipment in appropriate pre-determined area.

- For supplies, consumables, and equipment used throughout the gaseous monitoring program, document when these items are changed out or replaced. If available, include all relevant information such as: model number, lot number, and serial number.

Element 18 – Data Acquisition Requirements (Non-direct Measurements)

During the initial phase of planning for the implementation of a fine particle sampling network in New Hampshire, historical PM10 data from an existing network of samplers was used to predict expected areas of the state where fine particle sampling would be the most useful for characterizing the area for attainment of the new particulate standards. Typically, a crude estimation of potential ambient concentrations was derived by multiplying PM10 data by a factor of 0.66. The New Hampshire PM10 data that was used for this purpose was extracted from the AIRS database. New Hampshire PM10 data in the AIRS database has been fully quality assured in accordance with all applicable regulations and guidance.

In addition to these data, data from the Northeast Particulate Network (NEPART) were reviewed. These data follow the IMPROVE protocol (QA/QC procedures) and measure fine particulate mass (PM2.5 and PM10) and chemical composition of ambient aerosols in rural and remote Class I Areas (designated in the Clean Air Act) of the United States. NEPART data were collected from 1989 through 1993 at the summit of Mount Sunapee in New Hampshire. The data recorded at this site represents background and transport conditions for fine particles at an elevated (Mountaintop) site in Merrimack County.

Meteorological information provides a foundation for siting air monitoring stations and interpreting data recorded at monitoring stations. Meteorological information is gathered by the U.S. National Weather Service (NWS) at the Manchester airport and on the summit of Mount Washington. Additional meteorological information is available from ambient air monitoring sites operated by DES**.**

USGS maps were used as the primary means for locating and siting monitoring stations in the existing PM network. These maps, the location of existing PM monitoring sites, historical data, and meteorological information, along with knowledge of statewide emission sources, provided the raw information needed to determine the best location for a number of the PM2.5 monitoring sites.

Manufacturer's literature and sampler operation manuals are important sources of information that can be used by the site operators and other members of the monitoring team. As may be expected, the operator's manual and user's manual frequently provide useful information such as numerical formulas and constants associated with specific equipment. Errors sometimes occur in the manuals as may be expected, and appropriate cross checks will always need to be made to verify the reasonableness of the information contained in the manuals. The following types of errors can crop into manuals:

- insufficient precision
- outdated values for physical constants

- typographical errors
- incorrectly specified units
- inconsistent values within the manual
- use of different reference conditions than those called for by EPA.

If discrepancies are found, then the correct values must be determined and the manufacturer contacted so that corrections can be made. The field operators will make corrections to the operators manual and ask the vendor for an errata sheet discussing the changes. DES will also contact the Regional EPA office to inform them of these errors when they are discovered.

Element 19 – Data Management

19.1 Introduction

This section describes the data management operations pertaining to DES' PM2.5 Monitoring Program. Data management includes an overview of the mathematical operations and analyses performed on raw ("as-collected") PM2.5 data. These operations include data recording, validation, transformation, transmittal, reduction, analysis, management, storage, and retrieval.

19.2 Data Records

DES maintains records in several different formats, including handwritten logbook entries, field data sheets, electronic files and computer generated reports. The kinds of records that will be maintained, the individual(s) responsible for maintaining the records, and the location of the records are listed below. Because of data storage restrictions, the Information Resources Unit of the State of New Hampshire must periodically move older data records to backup media. PM2.5 data will not be moved to backup media until after the data are reported to AIRS. DES will retain all backup data for at least three years.

Program Implementation - records to be kept by the Air Monitoring Program Manager

Federal regulations and guidance
Sample network design and schedule
Equipment receipts and inspection reports
Vendor responses to equipment deficiencies
Laboratory coordination, contracts and communication
Quality Assurance and Audit results (field, laboratory, interagency)
Management System Review Reports
Network Review Reports
QA Annual Report
Audit Response/Corrective Action Reports

Sample Network Operation - records to be kept with Chief Technician

Sample operating schedules
Site operator log books
Sample filter changing schedule and filter time tracking
Scheduling and tracking of field quality assurance activities
Control Charts and Weighing Laboratory QC Materials

Maintenance and Quality Assurance - records to be kept with Chief Technician

Scheduling and tracking of field performance checks
Scheduling and tracking of routine sampler maintenance
Tracking of non-routine sampler maintenance and resolution
Tracking of vendor contact and response on non-routine sampler problems

Laboratory Record keeping - records to be kept with RTI

Filter receipt records
Filter inspection records
Filter weighing and tracking
Laboratory Quality Assurance *
Data generation and validation
Filter archiving tracking
Documentation of laboratory support activities

Data Recording, Validation, Assessment, and Reporting - records to be kept with the Data Manager

Data Management Audits
Sampler run data from the field
Laboratory filter weighing data
Quality assurance data flags
Final data reporting to AIRS
Data Assessment and Evaluation

19.3 Data Validation

Data validation is a combination of checking that data processing operations have been carried out correctly and monitoring the quality of the field operations. Data validation can identify problems in either of these areas. Once problems are identified, the data can be corrected or invalidated, and corrective actions (discussed further in C2 - Reports to Management) can be taken for field or laboratory operations. *Numerical data stored in the DES' PM2.5 Data Acquisition System (DAS or PDMT) are never internally overwritten by condition flags. Flags denoting error conditions or QA status are saved as separate fields in the data base, so that it is possible to recover the original data.*

The following validation functions are incorporated into the DES' PM2.5 DAS to ensure the quality of data entry and data processing operations:

- **Duplicate Key Entry** - the following data are subjected to duplicate entry by different operators: filter weight reports, field data sheets, chain of custody sheets. The results of duplicate key entry are compared and errors are corrected at biweekly intervals. The method

for entering the data at the weighing laboratory are provided in RTI's SOPs, *Standard Operating Procedures for Preparation, Weighing, and Data Recording for the $PM_{2.5}$ Monitoring Program.* Procedures for reconciling the duplicate entries in the laboratory are given in the RTI's Laboratory SOPs.

- **Range Checks** - almost all monitored parameters have simple range checks programmed in. For example, valid times must be between 00:00 and 23:59, summer temperatures must be between 10 and 50 degrees Celsius, etc. The data entry operator is notified immediately when an entry is out of range. The operator has the option of correcting the entry or overriding the range limit.
- **Completeness Checks** - When the data are processed certain completeness criteria must be met. For example, each filter must have a start time, an end time, an average flow rate, dates weighed, and operator and technician names. The data entry operator will be notified if an incomplete record has been entered before the record can be closed.
- **Internal Consistency and Other Reasonableness Checks -** Several other internal consistency checks are built into the PM2.5 DAS. For example, the end time of a filter must be greater than the start time. Computed filter volume (integrated flow) must be approximately equal to the exposure time multiplied by the nominal flow. Additional consistency and other checks will be implemented as the result of problems encountered during data screening.
- **Data Retention** - Raw data sheets are retained on file in the NH Air Resources Division office for a minimum of five years, and are readily available for audits and data verification activities. Physical samples such as filters may be discarded (after 5 years) with appropriate attention to proper disposal of potentially hazardous materials.
- **Statistical Data Checks** - Errors found during statistical screening will be traced back to original data entry files and to the raw data sheets, if necessary. These checks shall be run on a monthly schedule and prior to any data submission to AIRS.
- **Sample Batch Data Validation**- Appendix D, provides the flags that are generated by QC values outside of acceptance criteria, that may be associated with a sample batch. If batches contain too many flags (three or more) the batches may be rerun and/or invalidated.

19.4 Data Transformation

Data transformation can occur via internal sampler calculations for transforming raw data from measured units into final concentrations. These calculations are relatively straight forward, and many (transformations) are carried out in the sampler data processing unit before being recorded. The following conversions in Table 19.1 pertain to PM2.5 data:

Table 19.1 - Raw Data Calculations

Parameter	Units	Type of Conversion	Equation
Filter Volume (V_a) *	m^3	Calculated from average Flow Rate (Q_{ave}) in L/min, and total elapsed time (t) in min. multiplied by the unit conversion (m^3/L)	$V_a = Q_{ave} x t x 10^3$

Mass on Filter ($M_{2.5}$)	µg	Calculated from filter post-weight (M_f) in mg and filter pre-weight (M_i) in mg, multiplied by the unit conversion (µg/mg)	$M_{2.5} = M_f - M_i \, x \, 10^3$
$PM_{2.5}$ Concentration ($C_{PM2.5}$)	µg/ m^3	Calculated from laboratory data and sampler volume	$PM_{2.5} = \frac{M_{2.5}}{V_a}$

* - most FRM instruments will provide this value from the data logger.

19.5 Data transmittal

Data Transmittal occurs when data are transferred from one person or location to another, or when data are copied from one form to another. Two examples of data transmittal are collecting raw 5-minute sampler data on the widget and electronic transfer of data over a telephone or computer network. Table 19.2 summarizes data transfer operations.

Table 19.2 Data Transfer Operations

Description of Data Transfer	Originator	Recipient	QA Measures Applied
Collecting 5-min run data from sampler with Widget and downloading widget to network drive at office.	Operator	Data Processing Personnel	Double Key Entry
Electronic data transfer	(between computers or over network)	--	Parity Checking; transmission protocols
Filter Receiving and Chain-of-Custody	Shipping and Receiving Clerk	The PM2.5 DAS Computer (shipping clerk enters data at a local terminal)	Filter numbers are verified automatically; reports indicate missing filters and/or incorrect data entries
Calibration, FRM/FEM, and Audit Data	Auditor or field supervisor	PM2.5 Data base Computer	Entries are checked by Air Quality Supervisor and QA Officer
AIRS data summaries	Air Quality Supervisor	AIRS (U.S. EPA)	Entries are checked by Air Quality Supervisor and QA Officer

DES reports all PM2.5 ambient air quality data and information according to approved AIRS format. DES fully screens and validates this air quality data and information and submits it directly to the AIRS via electronic transmission, quarterly. The specific quarterly reporting periods and due dates are shown in the Table 19.3.

Table 19.3 Data Reporting Schedule

Reporting Period	Due Date
January 1-March 31	June 30
April 1-June 30	September 30
July 1-September 30	December 31
October 1-December 31	March 31

19.6 Data reduction

Data reduction involves aggregating and summarizing results so that they can be understood and interpreted in different ways. The PM2.5 monitoring regulations require certain summary data to be computed and reported regularly to EPA. Other data are reduced and reported for other purposes, such as station maintenance. Examples of data summaries include:

- average PM2.5 concentration for a station or set of stations for a specific time period.
- accuracy, bias, and precision statistics based on accumulated FRM data.
- data completeness reports based on numbers of valid samples collected during a specified period.

DES is currently implementing the data summary and analysis requirements contained in *40CFR Part 58, Appendix A*. Additionally, DES tracks the following specific summary statistics for the PM2.5 network:

- Single sampler bias or accuracy (based on collocated FRM data, flow rate performance audits, and FRM performance evaluations)
- Single sampler precision (based on collocated data)
- Network-wide bias and precision (based on collocated FRM data, flow rate performance audits, and FRM performance evaluations)
- Data completeness

Equations used for these reports are given in the Table 19.4.

Table 19.4 - Report Equations

Criterion	Equation	Reference
Accuracy of Single Sampler Flow - Single Check (d_i) X_i is reference flow; Y_i is measured flow	$d_i = \frac{Y_i - X_i}{X_i} x\ 100$	40 CFR 58 Appendix A, Section 5.5.1.1
Bias of a Single Sampler - Annual Basis (D_j)- average of individual percent differences between sampler and reference value; n_j is the number of measurements over the period	$D_j = \frac{1}{n_j} x \sum_{i=1}^{n_j} d_i$	5.5.1.2

Percent Difference for a Single Check (d_i) - X_i and Y_i are concentrations from the primary and duplicate samplers, respectively.	$d_i = \frac{Y_i - X_i}{(Y_i + X_i)/2} x 100$	5.5.2.1
Coefficient of Variation (CV_i) for a single Check	$CV_i = \frac{\lvert d_i \rvert}{\sqrt{2}}$	5.5.2.2
Pooled Coefficient of Variation, Quarterly Basis ($CV_{j,q}$). The CV_i will only be used when the two measurements are both greater than 6 µg/m3.	$CV_{j,q} = \sqrt{\sum_{i=1}^{n_j} \frac{CV_i^2}{n_{j,q}}}$	5.5.2.3 (a)
Completeness	$Completeness = \frac{N_{valid}}{N_{theoretical}} * 100$	--

19.7 Data Flagging -Sample Qualifiers

A sample qualifier or a result qualifier consists of 2 alphanumeric characters which act as an indicator of the fact and the reason that the data value (a) did not produce a numeric result, (b) produced a numeric result but it is qualified in some respect relating to the type or validity of the result or (c) produced a numeric result but for administrative reasons is not to be reported outside the laboratory. Qualifiers will be used both in the field and in the laboratory to signify data that may be suspect due to contamination, special events, or failure of QC limits. Some flags will be generated by the sampling instrument. While other qualifiers (flags) are generated by DES as in Element 22.3.2, and, some flags are generated by the filter weighing laboratory as in Element 23.5.2 of this QAPP. Appendix D contains a complete list of the data qualifiers for the field and laboratory activities. Qualifiers will be placed on field and bench sheets with additional explanations in free form notes areas. When sample batch information is entered into the DAS validation process run flags will be generated. During the sample validation process, the flags will be used to decide on validating or invalidating individual samples or batches of data.

19.8 Data Tracking

Data management includes tracking the status of data as they are collected, transmitted, and processed. The PM2.5 DAS contains the necessary input functions and reports necessary to track and account for the whereabouts of filters and the status of data processing operations for specific data. Information about filter location is updated by an appointed Technician II utilizing

electronic tracking procedures.

In most cases the tracking data base and the monitoring data base are updated simultaneously. For example, when the filter is pre-weighed, the weight is entered into the monitoring data base and the filter number and status are entered into the tracking data base. DES uses this type of electronic system developed by PDMT in addition to the paper forms used for chain-of-custody tracking.

Tracking reports may be generated by any personnel with report privileges on the DAS. The following tracking reports are available:

- Location of any filter (by filter number)
- List of all filters sent to a specified site that have not been returned
- List of all filters that have not been returned and are more than 30 days past initial weighing date
- List of all filters in the filter archive
- List of all filters that have been received but have not been post-weighed

The appointed Technician II is responsible for tracking filter status at least twice per week and following up on anomalies such as excessive holding time in the laboratory before re-weighing.

19.9 Data Storage and Retrieval

This section briefly discusses data storage and retrieval activities including security and time of retention, and documents the complete control system. This element also discusses performance requirements of the data processing system, including provisions for the batch processing schedule and the data storage facilities. Table 19.5 shows data archival policies for the PM2.5 Monitoring Program data. These policies apply to both the RTI Weighing Laboratory and to DES.

Table 19.5 - Data Archive Policies

Data Type	Medium	Primary Location	Retention Time	Final Disposition
Weighing records; chain of custody forms	Hardcopy	RTI	3 years	Discarded
Laboratory Notebooks	Hardcopy	RTI	3 years	N/A
Field Notebooks	Hardcopy	DES	3 years	Discarded
$PM_{2.5}$MP Data Base (excluding Audit Trail records)	Electronic (on-line)	DES	indefinite (may be moved to backup media after 5 years)	Backup tapes retained indefinitely
$PM_{2.5}$MP Audit Trail records	Electronic (backup	DES	3 years	Discarded

	tapes)			
Filters	Filters	RTI	1 year	Discarded

Security of PM2.5 data is ensured by the following controls:

- Password protection on the data base that defines three levels of access to the data
- Regular password changes (quarterly for continuing personnel; passwords for personnel leaving DES will be canceled immediately)
- Logging of all incoming communication sessions, including the originating telephone number, the user's ID, and connect times
- Storage of media including backup tapes in locked, restricted access areas.

Element 20 – Assessments and Response Actions

20.1 Introduction

This section outlines how DES will conduct an evaluation of the performance or effectiveness of the quality system for PM2.5, the deployment and operation of the particulate matter network, and the various measurement phases of data procurement and transfer (data operation). It describes the internal and external checks that are necessary to ensure that all of the elements of the QAPP are correctly implemented, that the data generated by the network is adequate, that corrective actions are implemented when needed and that the corrective actions are effective. DES, in implementing a fine particulate sampling program, will follow the requirements and guidance of all applicable Appendices to this document.

DES will undertake quality assurance assessments to determine if control efforts are adequate or improvements to the control efforts need to occur. DES documents all quality assurance and quality control efforts during data collection, data analysis, and data reporting phases. DES uses this information to determine the impact of control efforts on data quality (see Element 21 - Reports to Management). DES will use qualitative and quantitative assessments of the effectiveness of the internal and eternal checks to identify areas and activities that potentially compromise data quality.

DES will perform, or allow, the following assessments/evaluations to ensure the adequate performance of the internal and external checks of the quality system:

Management Systems Reviews
Network Reviews
Technical Systems Audits
Data Quality Assessments

20.2 Management Systems Review

A management systems review is a qualitative assessment of the entire PM2.5 data collection operation. Its purpose is to determine whether or not the management structure, policies, practices, and procedures for ensuring data quality are in place and adequate. DES will conduct Management Systems Reviews in conjunction with EPA's Technical Systems Audits (Section 20.4) every three years. These reviews and audits include all criteria pollutants and PM2.5. The reviews will include the quality assurance section of the Air Resources Division, the Air Monitoring Section, and data management support from the Information Resources Management Unit, or its equivalent replacement. The Director's Office staff will report its findings to the appropriate sub units within a reasonable amount of time after the review is complete. The report will be appropriately filed within the Directors office and with the Program manager.

Follow up progress on any corrective actions will be documented in writing to EPA and the Directors office.

20.3 Network Reviews

DES uses network reviews to determine how well the PM2.5 network is achieving its required air monitoring objective(s), and how it should be modified to continue to meet its objective(s). Network reviews will occur annually and follow *40 CFR Part 58 Appendices D and E*. DES will coordinate its network review activities with EPA Region I in order to perform the network reviews at the same time. The network review will consider:

- The date of the last review;
- Proposed network modifications since the most recent review;
- Results of any special studies, saturation sampling, orientation to point sources;
- Future or potential future re-designations of attainment/non-attainment areas; and
- Pollutant-specific problem areas or newly designated non-attainment areas.

Prior to the network review, the following information should be compiled and evaluated:

- network files (including updated site information and any site photographs);
- AIRS reports (such as AMP220, 225, 380, 390, 450) air quality data summaries for the most recent several years (3 to 5+ years);
- emission trend reports for major metropolitan areas or areas of concern, including emission density maps and emission source maps; and
- relevant summaries of meteorological data from the National Weather Service.

The information that is compiled should be checked to determine whether or not it is the most recent information, and checked for discrepancies. Any need to update photographs or files should be noted. The adequacy of the SLAMS and NAMS network will be determined using the following information:

- maps of historical monitoring data;
- maps of emissions densities and monitor locations;
- preliminary analysis of existing ambient data and emissions data;
- dispersion modeling;
- saturation or special studies;
- SIP requirements;
- site location objectives;
- revised monitoring strategies (e.g., re-engineering the air monitoring network); and
- best professional judgment.

An on-site visit should be conducted every three years, in accordance with *40 CFR Part 58 Appendix E* to determine compliance with siting requirements including probe height, distance to

trees, ground cover, etc. Prior to the visit the reviewer should familiarizes himself or herself with the most recent hard copy of site description (including photographs), data on the seasonal potential for high concentrations for the pollutant(s) of interest (inclusive of particulate matter), and predominant seasonal wind direction. A checklist which is similar to that used by EPA Region I should be used. The checklist can be found in the SLAMS/NAMS/PAMS Network Review Guidance document which assists reviewers determine conformance with Appendix E. The on-site review should also include, but not be limited to:

- the cleanliness of the inlet and any associated tubing;
- missing parts, frayed cords, instrument damage, etc.;
- previous findings in field notebooks and checklists;
- take photographs/videos of the site and the instruments; and
- document site conditions (with photographs or videos as necessary).

Additional network review discussion topics include:

- any installation of new monitors or relocation of monitors;
- any siting criteria problems and proposed solutions;
- any data submittal or data completeness problems;
- issues concerning maintenance and replacement of existing monitors and related equipments;
- any quality assurance problems;
- any special monitoring activities; and
- any funding or other regulatory issues.

An official report documenting the network review will be written within two months of the review by the Air Monitoring Section and appropriately filed.

20.4 Technical Systems Audits

A Technical System Audit (TSA), conducted by EPA Region I, is a thorough and systematic onsite audit which qualitatively reviews facilities, equipment, personnel, staff training, procedures and record keeping. The purpose of the TSA is to examine different aspects of the PM2.5 monitoring program to determine their conformance with the QAPP. DES performs Management System Reviews in conjunction with TSAs every three years. TSA's will be composed of three activities:

1 - Field (handling, sampling, shipping).
2 - Laboratory (pre-sampling weighing, shipping, receiving, post-sampling weighing, archiving, record keeping, and associated QA/QC).
3 - Data Management (information collection, flagging, data editing, security, uploading, reviewing).

TSA interviews will include individuals responsible for the overall planning and operation of the network, field operations, laboratory operations, QA/QC, data management, and data reporting. It is also important that some year-to-year (and site to site) uniformity in the audits occur.

The audit team will prepare a written summary of its findings. The summary will provide information on planning, field operations, laboratory operations, quality assurance/quality control, data management, and reporting. Particular attention will be given to problems in specific areas which have the potential to negatively influence data quality. Serious problems or deficiencies will be drafted as a formal Audit Finding and forwarded to the Air Monitoring Program Manager and the Director.

After the TSA, a post-audit systems audit report will be written. The report will include:

- audit title and number, and any other relevant identifying information;
- audit team leaders, audit team participants, and individuals that were audited;
- background information about the PM2.5 program, the purpose of the audit, dates of the audit, the particular measurement phase or parameters that were audited, and a brief description of the audit process;
- summary and conclusions of the audit, including proposed corrective actions; and
- attachments and appendices that include all audit evaluations and audit findings.

The audit report will be prepared by the audit team and completed within a reasonable amount of time after the completion of the audit. Shortly thereafter, it will be submitted to the appropriate branch and section managers, who will meet with the audit team to discuss the audit team's findings and recommendations. Comments by the branch and section chiefs will be incorporated in the final audit package, along with an agreed-upon schedule for corrective action(s).

As part of the follow-up procedures to the TSA and the audit report, the Quality Assurance Section and the affected branches and sections will periodically meet to ensure that corrective actions are undertaken in a timely fashion. Any unresolved issues will be submitted to the DES Director for resolution.

20.5 Data Quality Assessments

It is important that the data produced by the PM2.5 network accurately and precisely measure ambient concentrations of PM2.5. DES will use data quality assessments to determine whether or not the quality of the data is adequate to support decisions based on the Data Quality Objectives (Element 7). The data quality assessment discussed later in this QAPP focuses on determining if the level of uncertainty of the data is such that the data can be used for subsequent air quality related determinations. The assessment process is described in detail in *Guidance for the Data Quality Assessment Process, EPA QA/G-9*. A brief synopsis of the five elements of the assessment process is presented below.

- Review the data quality objectives and sampling design of the program: review the DQO's or develop them if they do not exist. Define the quantitative working assumptions (statistical hypothesis), tolerance limits and/or confidence intervals.
- Conduct a preliminary review of the data. Review precision and accuracy (P&A) and other available relevant data, calculate summary statistics (arithmetic mean, median, geometric mean, range, standard deviation of the mean), plots and graphs. Scan all data for data patterns, relationships and potential anomalies.
- Select a statistical method (and its underlying statistical test assumptions) to best test the data assumptions, based on the preliminary review of the data
- Verify test assumptions: determine whether or not the underlying assumptions made by the test method hold true for the data.
- Conduct the appropriate statistical analyses: perform the tests and document inferences from the tests.

The results of this process will be included in the Quality Assurance Annual Report which will be prepared by a team of staff from the air monitoring section, the quality assurance section and the section responsible for data management.

Measurement uncertainty will be estimated for both automated (sequential) methods and manual methods. *40 CFR Part 58 Appendix A* terminology will be followed. Precision, accuracy, and bias will be determined. The individual results of these tests shall be reported to EPA.

20.6 Documentation of Assessments

The following material describes what will be documented in the QAPP after consideration of the above issues and types of assessments. The table below presents the type of assessment, its frequency the responsible personnel, the completion dates for reports, and information on reporting/resolution.

Table 20.1 Assessment Summary

Assessment Activity	Frequency	Personnel Responsible	Schedule	Report Completion	Reporting/Resolution
Management Systems Reviews	1/3 years	Director's Office	6/1/00	30 days	Director's Office to QAS, AMS, and supporting teams
Network Reviews					
App D	1/year	AMS*	6/1/00	30 days	AMS
App E	1/3 years	AMS	6/1/00	30 days	QAS to AMS
Technical Systems Audits	1/3 years	QAS**	9/1/00	30 days	QAS to AMS
Data Quality Audits	1/year	QAS	9/1/00	30 days	QAS to AMS
Data Quality Assessment	1/year	QAS	6/1/00	120 days	NHARD to EPA Reg. I

* Air Monitoring Section
** Quality Assurance Section

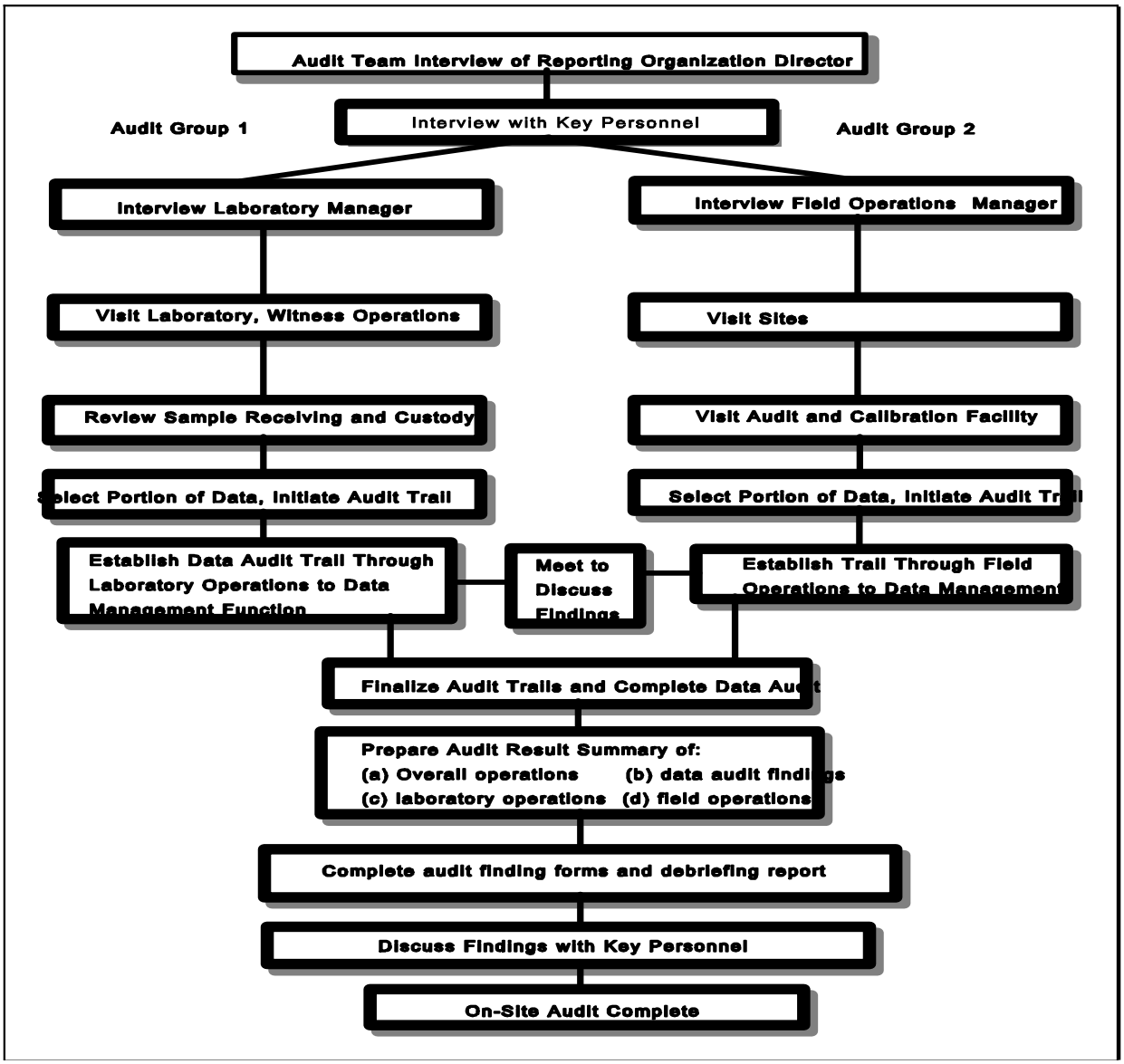


Figure 20.1 Audit Activities List

Element 21 - Reports to Management

21.1 Introduction

This section describes the quality-related reports and communications that are necessary to support SLAMS/NAMS PM2.5 network operations, including data acquisition, data validation, data assessment, and report writing. Periodic reports to management are important because they alert managers to potential data quality problems, propose potential solutions to problems, and provide the basis for providing adequate resources to operate and maintain the PM2.5 network.

Effective communication is essential to developing, operating and maintaining a quality PM2.5 program. Regular planned quality reporting provides a method to communicate to management the status of the following important components of the PM2.5 program:

- adherence to scheduled delivery of data and reports;
- documentation of deviations from approved quality assurance and test plans, and a determination of the consequences of the deviations on data quality; and
- analysis of potential uncertainties in decisions that are based on the data.

A quality assessment (the evaluation of the technical systems, the measurement of performance, and the assessment of the data) is conducted to help ensure that the measurement results meet the program objectives and that any necessary corrective actions are taken quickly.

21.2 Frequency, Content, and Distribution of Reports

40 CFR Parts 50, 53, and 58 discuss required reports to management for the PM2.5 monitoring program. Guidance report formats and content for these reports are presented in guidance by EPA's Quality Assurance Division (QAD) and the Office of Air Quality Planning and Standards (OAQPS). These reports are described in the following subsections.

21.2.1 QA Annual Report

Periodic assessments (reports) of the SLAMS data are required to be reported to EPA as per *40 CFR 58 Appendix A, Section 1.4, revised July 18, 1997*. DES is responsible for the issuance of the QA Annual Report. The report describes the quality objectives for measurement data obtained from the PM2.5 monitoring program and how these objectives were met. In addition, the QA Annual Report also provides an annual review of the SLAMS air quality surveillance system to determine whether or not the system meets the monitoring objectives defined in *40 CFR Part 58, Appendix D*. The review will identify any needed modifications to the network, such as the termination or relocation of stations, and the establishment of new stations.

The QA Annual Report will include information for each ambient air pollutant in the New Hampshire air quality monitoring network.

The QA Annual Report will contain the following summary information for reporting PM2.5 measurement uncertainties (as per *40 CFR 58 Appendix A, Section 3.5, revised July 18 1997*):

Flow rate (Section 3.5.1)
Collocated Federal Reference Method Samplers (Section 3.5.2)
Collocated Equivalent Samplers of the same design (Section 3.5.2)
An assessment of bias based on the FRM audit procedure (Section 3.5.3)

21.2.2 Network Reviews

The EPA Regional Office prepares annual network reviews in accordance with the requirements of *40 CFR Part 58.20(d)*. The purpose of the annual network review is to determine if the components of the monitoring system meet the monitoring objectives defined in *40 CFR Part 58 Appendix D*. The review identifies any modification to the network, including site relocation or termination, and the establishment of new monitoring sites. The information that is gathered for the review is coordinated through the DES. DES will assist in the provision and support of information for this review. The Director of DES is responsible for ensuring that changes identified in the annual review are included in future program planning. DES Branch and Section managers are responsible for implementing review findings that influence data quality.

As required by *40 CFR Part 58 Appendix A, Section 4(a), revised July 18, 1997*, the Director of DES is responsible for submitting a list of all monitoring sites with their AIRS site identification codes to the EPA Regional Office and to the AIRS. Whenever there is a change in the list of monitoring sites in the air monitoring network, the Director of DES will report this change to the EPA Regional Office and to AIRS.

21.2.3 Quarterly Reports

Each quarter, DES will report to AIRS the results of all Precision and Accuracy (P&A) and bias tests that have been carried out in the previous quarter. These quarterly reports will be submitted, consistent with the data reporting requirements specified for air quality data as set

forth in *40 CFR Parts 58.26,58.35 (SLAMS and NAMS), and 40 CFR Part 58 Appendix A, Section 4*, as presented in Table 21-1.

Table 21-1. Quarterly Reporting Schedule

Reporting Period	Due on or Before
January 1 - March 31	June 30
April 1 - June 30	September 30
July 1 - September 30	December 31
October 1 - December 31	March 31 (following year)

In accordance with Federal Register Notice of July 18, 1997, all QA/QC data collected will be reported and appropriately flagged (Appendix D). These data include: 'results from invalid tests, from tests carried out during a period of time for which ambient data immediately prior to or subsequent to the tests were invalidated for appropriate reasons, and from tests of methods or analyzers not approved for use in SLAMS monitoring networks...' (*40 CFR Part 58 Appendix A, Section 4, revised July 18, 1997*).

21.2.4 Technical System Audit Reports

DES will perform internal systems audits every three years, as discussed in Element 20. Reports from these audits will be issued and reviewed internally by a DES team composed of staff and managers from the air monitoring program. DES will file audit reports appropriately and make them available to EPA Regional staff prior to their external TSA.

EPA will conduct an external TSA every three years, as required by *40 CFR Part 58, Appendix A, Section 2.5*.

21.2.5 Response/Corrective Actions

DES Technicians will fill out a Deficiency Report (Pink Slip) whenever a problem is found such as a safety defect, an operational problem, or failure to comply with procedures (See Figure 21 and Appendix B.). The Pink Slip, which is a closed loop system, is one of the most important ongoing reports to management since it documents primary QA activities and provides valuable records of QA activities that can be used in other summary reports. Each form will have: the identity of the originator, the identified problem, any suggested solution(s), individuals who may carry out the suggested corrective action, and the schedule for completion of the corrective action (by the individuals supervisor). After the problem has been resolved, the individual who conducted the corrected action will state on the form how the problem was resolved and the effectiveness of the solution. Copies of the Pink Slip will be distributed twice by the person

filling out the form: first when the problem is discovered and the corrective action has been scheduled; and second after the corrective action has been completed.

21.3 Responsible Organizations and Individuals

This section identifies the responsibilities of individuals, or teams, who prepare the reports, evaluate their impacts, and implement follow-up actions involved in QA reporting.

Commissioner of the New Hampshire Department of Environmental Services. The ultimate responsibility for the quality of the data and the technical operation of the PM2.5 monitoring network rests with the Commissioner of DES. The Commissioner's responsibilities, with respect to air quality reporting, are delegated to the director of the New Hampshire Air Resources Division. These responsibilities include defining and implementing the document management and quality assurance systems for the PM2.5 monitoring network (including assessment activities).

Director of the New Hampshire Air Resources Division. The Director is responsible for the operation of the air monitoring network. The Division Director is also responsible for the timely submittal of quarterly and annual data summary reports. The Director works closely with the Air Monitoring Program Manager in ensuring that the QA procedures, arranging of audits, and QA data reporting procedures are followed.

Quality Assurance Supervisor. This Section Manager is responsible for establishing QA policies and systems for air monitoring activities within DES. This Section Manager is responsible for the QA Annual Report and supervises members of the Quality Assurance Section within DES. Additional duties of the Quality Assurance Supervisor include:

- assisting the Program Manager with data quality assessments and other internal audits;
- calculating and/or reviewing P&A and bias data generated by the collocated PM2.5 monitors;
- reviewing control charts and other laboratory QC materials provide by RTI; and
- monitoring Response/Corrective Action Reports.

Data Manager. The Data Manger is responsible for coordinating the information management activities for SLAMS/NAMS data. Specific responsibilities include:

- ensuring access to data for timely reporting and interpretation; and
- ensuring the timely delivery of all required data to the AIRS system.

Program Manager. The Program Manager is responsible for identifying problems and ensuring corrective action. The Program Manager is also responsible for assuring that technicians and site operators maintain their documentation files in the monitoring network design. Supervisors are responsible for disseminating information appearing in audit reports and other quality-related

documents to operations personnel.

Laboratory Branch Manager (RTI). The Laboratory Branch Manager, who is an employee of RTI, is responsible for identifying problems and ensuring corrective action related to laboratory activities. The Laboratory Branch Manager is responsible for reviewing laboratory QC data, including control charts, and for assuring that any repairs and preventive maintenance activities are completed and effective. The Laboratory Branch Manager is also responsible for assuring that laboratory personnel maintain their documentation files as defined in the relevant Laboratory SOPs. All relevant information regarding laboratory performance, internal systems audits, control charts and other QC materials, supporting QA/QC forms, and data handling information will be disseminated in a timely manner to the Air Branch Manager and Quality Assurance Section Manager of DES.

Field and Laboratory Technicians and Site Operators. Individual technicians and site operators are generally not responsible for authoring reports to management. These personnel, however, will participate in the over all preparatory work by furnishing control charts and forms, identify the need for new corrective action, and maintain other quality related information that may be used in the QA reports. They are an integral part of the QA review team and as such should be trained in appropriate QA procedures and practices.

Figure 21.1. Audit Response/Corrective Action Form

AIR QUALITY MONITORING SITE DEFICIENCY REPORT

SITE NAME:_____LOCATION OF SITE:_____

REPORTING TECHNICIAN:_____DATE OF REPORT:_____

DESCRIPTION OF DEFICIENCY:

RECOMMENDED CORRECTIVE ACTION:

REPAIR TECHNICIAN ASSIGNED:_____ DATE:_____
DESCRIPTION OF REPAIR/CORRECTIVE ACTION:

COMPLETION DATE:_____

SUPERVISOR APPROVAL/AUTHORIZATION:_____

Element 22 – Data Review, Validation and Use

22.1 Introduction

This section of the QAPP describes how DES will verify and validate the data collection procedures associated with the PM2.5 air monitoring program. Verification can be defined as confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. Validation can be defined as confirmation by examination and provision of objective evidence that the particular requirements for a specified intended use are fulfilled. The major objective of the New Hampshire PM2.5 air monitoring network is to determine whether or not the measured ambient concentrations of PM2.5 meet or exceed the PM2.5 NAAQS standards.

The Air Monitoring Program Manager, the Data Manager and the QA Supervisor facilitate data review, verification and validation. These data assessments occur prior to submitting data to AIRS and prior to final data quality assessments. DES considers sampling design, sampling procedures, sample handling, analytical procedures and QC during the data review, verification and validation processes.

22.2 Sampling Design

How closely a measurement represents the actual environment at a given time and location is a complex issue that DES considers during development of the sampling design. Through routine operations, DES checks each sample for conformity to the specifications, including type and location (spatial and temporal). By noting the deviations in sufficient detail, subsequent data users will be able to determine the data's usability under scenarios different from those included in project planning.

DES verifies the sampling design through three processes, Network Design Plan confirmation, internal network reviews and external network reviews. DES must obtain approval from EPA for the Network Design Plan. This plan discusses the initial deployment of the network. Once a year, DES performs a network review to determine whether the network objectives, as described in the Network Design Plan, are still being met. And, every three years the EPA will conduct a network review to determine whether the network objectives, as described in the Network Design Plan, are still being met. Inadequacies noted during these reviews will likely result in changes to the Network Design Plan and are addressed through coordination with EPA.

22.3 Sample Collection Procedures

Details of how a sample is separated from its native time/space location are important for properly interpreting the measurement results. Sampling methods and field SOPs provide these details, which include sampling and ancillary equipment and procedures. DES will document acceptable departures (for example, alternate equipment) from this and associated action if the

requirements cannot be satisfied. The Program Manager eliminates all unacceptable data from the quarterly reporting package to the EPA by notifying the Data Manager. The Program Manager flags data that are considered good, but not collected under restrictions of this QAPP.

22.3.1 Sample Collection Verification

Sample collection procedures are described in detail in Element 11 and are developed to ensure proper sampling to maintain sample integrity. DES will use Internal Technical Systems Audits and External Technical Systems Audits to verify sample collection activities. EPA will conduct external TSAs every three years. DES will conduct internal TSAs every three years as described in Element 20, during the year following the EPA TSA.

DES will use both types of TSAs to ensure adherence with sample collection requirements. DES will note deviations from the routine sample collection activity during audits and correct the deviations using procedures described in Section 20.

22.3.2 Sample Collection Validation

DES places QC samples throughout the measurement process to help validate the sample collection activities. DES will flag or invalidate, after a thorough investigation, any data that indicates unacceptable levels QC. The Program Manager uses the procedures described in Element 23 of this QAPP to perform sample collection validation.

22.4 Sample Handling

Details of how a sample is physically treated and handled during relocation from its original site to the actual measurement site are extremely important. Correct interpretation of the measurement results requires that DES detail deviations from required sample handling methodology and take action to minimize or control the changes. Data collection activities should indicate events that occur during sample handling that may affect the integrity of the samples. DES checks sample containers or conveyance systems to ensure that they are appropriate to the nature of the sample and the type of data generated from the sample. DES conducts checks of the PM2.5 samplers 5-minute data to ensure that the sample is representative as it was collected. Further, DES conducts monthly inspections of the sample handling equipment, as part of the routine monthly inspection process described in Element 20 and Element 16 of this QAPP.

22.4.1 Sample Handling Verification

As mentioned in Section 22.2.1, DES will use both internal and external TSAs to ensure adherence to required sample handling methodologies. The audits include checks on the identity of the sample collection location, sample conveyance system to ensure that the sample that is

analyzed is representative of its native environment as it moves through the data collection operation.

22.4.2 Sample Handling Validation

In general, when data show acceptable precision and bias, the sample handling activities are adequate. DES will flag and investigate any data that indicates unacceptable levels of bias or precision. DES will base any decision on the validity of measurement data obtained during a period of unacceptable precision or bias on the findings of a follow-up investigation as described by the Procedures in Element 23 of this QAPP.

22.5 Analytical Procedures

DES verifies each sample to ensure that the sample was analyzed with acceptable procedures. EPA has defined acceptance criteria for important components of the procedures, along with suitable codes for characterizing each sample's deviation from the procedure (Element 13). Data validation activities should determine how seriously a sample deviated beyond the acceptable limit so that the potential effects of the deviation can be evaluated during data quality assessment.

22.5.1 Analytical Procedures Verification

As mentioned in Section 22.2.1, DES will use both internal and external TSAs to ensure adherence to the required analytical method specifications. The audits will include checks on the identity of the sample. DES will note deviations from the analytical procedures in audit finding forms and correct the deviations using the procedures described in Element 20 of this QAPP

22.5.2 Analytical Procedures Validation

Similar to the validation of sampling activities, DES will use the review of data from audits, calibration checks, and other laboratory QC that are described in Elements 14 and 16 of this QAPP to validate the analytical procedures. In general, when data show acceptable precision and bias, the analytical procedures are adequate. DES will base any decision on the validity of measurement data obtained during a period of unacceptable precision or bias on the findings of a follow-up investigation as described in Element 23 of this QAPP.

22.6 Quality Control

The quality control section of this QAPP specifies the QC checks that are performed during sample collection, handling and analysis. These include zero, precision checks, calibration checks, calibrations and audits which provide indications of the quality of data being produced by specified components of the measurement process. For each specified QC check, the procedure, acceptance criteria, and corrective action (and changes) are specified in Element 14

and various Appendices of this QAPP. Data validation activities document DES' corrective actions, which samples were affected, and the potential effect of the actions on the validity of the data. Please refer to Element 14, Quality Control, of this QAPP for more information on QC.

Element 23 – Verification and Validation Methods

23.1 Introduction

This section describes verification and validation procedures that DES and EPA will undertake for key aspects of the PM2.5 Monitoring Program to determine if the proper procedures (and where necessary corrective actions) are undertaken to ensure data integrity.

Many of the processes for verifying and validating the measurement phases of the PM2.5 data collection operation have been discussed in the previous Section. If these processes, as written, are followed and the sites are correctly deployed, then it can be anticipated that data produced from these sites will achieve the PM2.5 DQOs. Exceptional field events may occur and field and laboratory actions may adversely influence the integrity of the samples, however. Additionally, some QC checks may fail to meet acceptance criteria. Potential problems that influence the data quality are identified in the form of flags. These flags are presented in Appendix D of the QAPP and constitute an important component of the routine checks that must be done to assure quality data. When data compromising flags are identified, then it will be necessary to determine how these problems may affect data quality.

The criteria that are deemed critical to maintaining the integrity of a sample or a group (batch) of samples are presented in Table 23.1, the Critical Criteria Table. Observations that do not meet each and every criterion on this table will be invalid unless compelling reasons and/or justifications for over-riding the invalidation are presented, accepted by the QA Supervisor, and subsequently documented. Samples, or a group of samples for which one or more of the criteria are not met are considered invalid, unless proven otherwise. The cause or causes of the invalidation will be investigated and minimized (if possible) to reduce the likelihood of invalidating additional samples.

Information about filter holding times, sampling period, visual field filter checks, and sampling instrument(s) will be provided by DES for criteria evaluation. Information about the filter conditioning environment and laboratory related calibration/ verification will be provided by RTI from their weighing laboratory.

Criteria that are important for maintaining and evaluating the quality of the data collection system are presented in Table 23.2, the Operational Evaluations Table. Violation of one of these criteria or a number of criteria may, or may not, cause the sample or samples to be considered invalid. When considering the validity of samples, DES will consider other quality control information that may, or may not, indicate that the data are acceptable for the parameter being controlled. The sample, or group of samples, for which one or more of these criteria are not met, will be considered suspect until other quality control information demonstrates otherwise. The reason, or reasons, for not meeting criteria in this table will be investigated, documented, and

subsequently mitigated or justified.

Criteria relative to the data collection system include: filter checks, filter holding times, laboratory QC checks, sampling instruments, calibration/verification checks, precision checks, accuracy checks, field calibration and check standards, and monitor maintenance checks. RTI will provide information on the laboratory QC checks (including filter checks and filter holding times) to DES for evaluation. All other information will be provided by DES for its violation determination of data collection system criteria.

23.2 Sampling Design Verification

Two processes will be used to verify if the sampling design is appropriate to represent the population of interest at adequate levels of spatial and temporal resolution as described in EPA guidance.

- **Internal Network Reviews** - DES will perform an annual network review to determine whether or not the network objectives, as described in the Network Design Plan, continue to be met, and that the sites are meeting siting requirements.

- **External Network Review** - The EPA Regional Office will conduct a network review every three years to determine whether or not the network objectives, as described in the Network Design Plan, are still being met, and that the sites are meeting siting criteria.

23.3 Sampling Design Validation

Knowledge of local emission and meteorological conditions and the ambient air data measured at the PM2.5 monitoring network can be used to validate the sampling design. In addition, the process described in Element 10 can be used to confirm the network design.

23.3.1 Sample Collection Verification

Sample collection procedures, described in Appendix E (SOPs), were developed to ensure proper sampling and sample integrity. Both internal and external TSAs will be used to verify that the sampling procedures are being performed as described in this QAPP and the SOPs.

23.3.2 Sample Collection Validation

The QC samples that are used in the measurement process can help validate the activities at each phase of sampling. Review of QC data such as the collocating sampling data, field blanks, the FRM performance evaluation, and the sampling equipment verification checks that are described in Element 11 can be used to validate the data collection activities. Any data that show unacceptable levels of bias or precision, or a tendency (as indicated by a trend on the control chart) will be flagged and investigated.

23.4 Sample Handling

The details of how a sample is physically treated and the handling procedure during relocation from its original site to the actual measurement site are very important. Data collection activities should indicate events that occur during sample handling that may possibly influence the integrity of the samples. Sample handling (Element 12) is one of the phases where inappropriate techniques can have a significant influence on sample integrity and data quality. Therefore, checks on the identity of the sample (e.g., proper labeling and chain of custody records) as well as proper physical/chemical storage conditions (e.g., chain of custody and storage condition records), will be made to ensure that the sample maintains representativeness as it moves from the measurement site through the analytical process.

23.4.1 Verification of Sample Handling

Both internal and external TSAs will be performed to ensure that the specifications discussed in the QAPP are followed. The audits will include checks on the identity of the sample, packaging in the field, transport conditions, and proper storage conditions that ensure the representativeness of the sample.

23.4.2 Validation of Sample Handling

A review of the co-located sampling data, along with information on field blanks, and the FRM performance evaluation (Element 12) will be used to validate the sampling handling activities. Any data that indicates potentially unacceptable levels of bias or precision problems, or a tendency (as indicated by a trend on the control chart) will be flagged and investigated.

23.5 Analytical Procedures

Each sample will be verified to ensure that the procedures used to generate the data (see Element 13) have been implemented as specified. Data validation activities will determine how seriously a sample has deviated from the acceptable limit so that potential effects of the deviation can be evaluated during the Data Quality Assessment. Acceptance criteria (Element 14, Table 14.1) for important components of the procedures, along with suitable codes for characterizing each sample's deviation will be included in the validation activities.

23.5.1 Verification of Analytical Procedures

Both internal (by RTI) and external technical systems audits will be performed to ensure that laboratory analytical method specifications discussed in the RTI SOP's are being followed. The audits will include checks on the identity of the sample. Deviations from the analytical procedures will be noted in the audit finding forms and corrected, as per the procedures described in the RTI SOP's.

23.5.2 Validation of Analytical Procedures

A review of data from laboratory blanks, calibration checks, laboratory duplicates, and other laboratory QC that are described in the RTI SOP's, will be used to validate analytical procedures. Unacceptable levels of bias or precision, or a tendency (trend in a control chart) will be flagged and investigated by RTI. Information regarding bias and precision will be forwarded to the Quality Assurance Section of DES.

23.6 Quality Control

Quality control checks will be carried out during sample collection, sample handling and sample analysis. The analysis checks will include standards, blanks, and replicates which may provide indications of the quality of data that is being produced by specific components of the sampling process. The procedure, acceptance criteria, and corrective actions will be specified for each QC check (Elements 14, Table 14.1). Data validation activities will include documentation of corrective actions, affected samples, and the potential effects of the remedial actions on the validity for the data.

23.6.1 Verification of Quality Control Procedures

Internal and external TSAs will be performed to ensure the quality control methods specifications in the QAPP are followed.

23.6.2 Validation of the Quality Control Procedures

Validation of QC procedures will require a review of the documentation of the corrective actions that were taken when the QC samples failed to meet acceptable criteria, and a review of the potential effect of the corrective action(s) on the validity of the data.

23.7 Calibration

Calibration of instruments and equipment, and associated information will be presented to ensure that calibrations:

- were performed within an acceptable time period prior to the generation of measurement data;
- were performed in the proper sequence;
- included the proper number of calibration points;
- were bracketed with standards that encompass the range of reported measurement results; and
- had acceptable linear checks and other checks to ensure that the measurement system was stable when the calibration was performed

When calibration problems are identified, any data produced between the suspect calibration event and any subsequent re-calibration will be flagged to alert data users. Calibration activities associated with laboratory weighing will be carried out by RTI, as written in the RTI SOP's. Field calibration of instruments associated with the PM2.5 air monitoring program will be conducted by the DES (Element 16).

23.7.1 Verification of Calibration Procedures

RTI will ensure that all the appropriate laboratory calibrations will be undertaken and pertinent information will be provide to DES on a routine basis. Internal and external technical systems audits will be performed for laboratory functions to ensure the calibration specifications and corrective actions discussed are followed. Internal and external TSAs will be performed for field functions to ensure that the calibration specifications and corrective actions for field related activities (Element 16) are followed.

23.7.2 Validation of Calibration Procedures

Calibration data for field measurements will be reviewed and any data that indicates unacceptable levels bias or problems with precision, or a tendency as may be reflected by a trend in the control chart, will be flagged and investigated as described in Element 16. The investigation should include a review to determine inappropriate calibration procedures or equipment problems. The validation will also include a review of pertinent documentation to ensure that corrective action was taken as described in the QAPP.

23.8 Data Reduction and Processing

As mentioned previously, internal and external TSA's will be performed to ensure that data reduction and processing procedures have been followed. Data reduction involves an irreversible process which leads to a loss of detail in the data. Reduction activities include calculating averages across time and/or space. Potential data anomalies will be investigated using simple statistical analysis and graphical techniques.

23.8.1 Validation of Data Reduction and Processing Procedures

As part of the data quality audits a number of sample IDs, chosen at random, will be identified and all raw files pertaining to these samples will be reviewed. Data files including the following will be reviewed:

pre-sampling weighing activity
pre-sampling
sampling (sampler download information)
calibration information representing the period of sampling

sample handling/custody
post-sampling weighing
corrective action(s)
data reduction

The raw data will be reviewed and final concentrations will be calculated by hand to determine if final values submitted to the AIRS-AQS compare to the hand calculations. All associated data flags will also be reviewed, along with other data qualifiers to determine appropriate associations, and whether or not appropriate corrective actions were taken.

Table 23.1

CRITICAL CRITERIA TABLE [a] S- Single Filter, G- Group of filters (i.e. batch), G1-Group of filters from 1 instrument				
Criteria	Acceptable Range	Frequency	AIRS FLAG	Local FLAG
Filter Holding Times				
Sample Recovery	177 hours from sample end date	all filters	1	SR
Post-sampling Weighing	• 10 days at 25• C from sample end date, or • 30 days at 4• C from sample end date *See 1/20/00 memo on filter cassette transport http://www.epa.gov/ttn/amtic/pmpolgud.html*	all filters	1	FT
Sampling Period (including multiple power failures)	1380-1500 minutes, or value if < 1380 and exceedance of NAAQS 1/ midnight to midnight	all filters	Y	
Sampling Instrument				
Average Flow Rate	average within 5% of 16.67 liters/minute	24 hours of op	1	AF
Variability in Flow Rate	CV • 2%	24 hours of op	1	VF
Filter				
Visual Defect Check (unexposed)	see reference	all filters	NA	
Filter Conditioning Environment				
Equilibration	24 hours minimum	all filters	1	EQ
Temp. Range	24-hr mean 20-23• C	all filters	1	TR
Temp.Control	± 2• C SD* over 24 hr	all filters	1	TC
Humidity Range	24-hr mean 30% - 40% RH or • 5% sampling RH but > 20%RH	all filters	1	HR
Humidity Control	± 5% SD* over 24 hr.	all filters	1	HC
Pre/post Sampling RH	difference in 24-hr means • ± 5% RH	all filters	1	RH
Balance	located in filter conditioning environment	all filters	NA	
Calibration/Verification				
One-point FR Check	± 4% of transfer standard	1/4 weeks	1	FR

1/ value must be flagged
*= variability estimate not defined in CFR
SD= standard deviation
CV= coefficient of variation
NA- Not applicable for a flag in AIRS

Table 23.2

OPERATIONAL EVALUATIONS TABLE
[a] S- Single Filter, G- Group of filters (i.e. batch), G1-Group of filters from 1 instrument

Criteria	Acceptance Range	Frequency	Samples Impacted [a]	AIRS FLAG	Local FLAG
Filter Checks					
Lot Blanks	less than 15 • g change between weighings	9 filters per lot	G	NA	
Exposure Lot Blanks	less than 15 • g change between weighings	3 filters per lot	G	NA	
Filter Integrity (exposed)	no visual defects	each filter	S	NA	
Filter Holding Times					
Pre-sampling	< 30 days before sampling	all filters	S	2	HT
Lab QC Checks					
Field Filter Blank	± 30 • g change between weighings	10% or 1 per weighing session	G/Gl	2	FB
Lab Filter Blank	± 15 • g change between weighings	10% or 1 per weighing session	G	2	LB
Balance Check	• 3 • g	beginning, 10th sample, end	G	NA	
Duplicate Filter Weighing	± 15 • g change between weighings	1 per weighing session	G	NA	
Sampling Instrument					
Individual Flow Rates	no flow rate excursions > ±5% for > 5 min. [1/]	every 24 hours of op	S	W or T [2/]	
Filter Temp Sensor	no excursions of > 5• C lasting longer than 30 min [1/]	every 24 hours of op	S	X or T [2/]	
Calibration/Verification					
External Leak Check	< 80 mL/min	every 5 sampling events*	Gl	2	EL
Internal Leak Check	< 80 mL/min	every 5 sampling events	Gl	2	IL
Temperature Calibration	± 2• C of standard	if multi-point failure	Gl	NA	
Temp M-point Verification	± 2• C of standard	on installation, then 1/yr	Gl	NA	
One-point Temp Check	± 4• C of standard	1/4 weeks	Gl	2	TP
Pressure Calibration	± 10 mm Hg	on installation, then 1/yr	Gl	NA	
Pressure Verification	± 10 mm Hg	1/4 weeks	Gl	2	BP
Other Monitor Calibrations	per manufacturers' operating manual	per manufacturers' op manual	G	2	?
Lab Temperature	± 2• C	1/6 months	G	2	LT
Lab Humidity	± 2%	1/6 months	G	2	LH
Flow Rate (FR) Calibration	± 2% of transfer standard	if multi-point failure	Gl	NA	
FR Multi-point Verification	± 2% of transfer standard	1/yr	Gl	NA	
Design Flow Rate Adjustment	± 2% of design flow rate	at one-point or multi-point	Gl	2	DF
Mirobalance Calibration	Manufacturer's specification	1/yr	G	NA	
Precision					
Collocated Samples	CV ≤ 10% of samples > 6 • g/m^3	every 6 days for 25% of sites	G	NA	

Table 23.2 (continued)

OPERATIONAL EVALUATIONS TABLE

[a] S- Single Filter, G- Group of filters (i.e. batch), G1-Group of filters from 1 instrument

Criteria	Acceptance Range	Frequency	Samples Impacted [a]	AIRS FLAG	Local FLAG
Accuracy					
Temperature Audit	± 2• C	4/yr	G1	NA	
Pressure Audit	±10 mm Hg	4/yr	G1	NA	
Balance Audit	± 0.050 mg or manufacturers specs, whichever is tighter	1/yr	G	NA	
Flow Rate Audit	± 4% of audit standard ± 5% of design flow rate	1/2wk (automated) 4/yr (manual)	G1	2	FA
Calibration & Check Standards (working standards)					
Field Thermometer	± 0.1• C resolution, ± 0.5• C accuracy	1/yr	G/G1	NA	
Field Barometer	± 1 mm Hg resolution, ± 5 mm Hg accuracy	1/yr	G/G1	NA	
Working Mass Stds. (compare to primary standards)	0.025 mg	1/3 mo.	G	NA	
Monitor Maintenance					
Impactor	cleaned/changed	every 5 sampling events	G1	NA	
Inlet/downtube Cleaning	cleaned	every 15 sampling event	G1	NA	
Filter Chamber Cleaning	cleaned	monthly	G1	NA	
Leak Check[w]	see *Calibration/Verification*				
Circulating Fan Filter Cleaning	cleaned/changed	monthly	G1	NA	
Manufacturer-Recommended Maintenance	per manufacturers' SOP	per manufacturers' SOP	G1	NA	

1/ value must be flagged

2/ These are sampler defined flags. If only one sampler defined flag is generated the first flag is used , if there are multiples the "T" is used

*= variability estimate not defined in CFR

[w]= Scheduled to occur immediately after impactor cleaned/changed.

SD= standard deviation

CV= coefficient of variation

NA- Not applicable for a flag in AIRS

Element 24 – Reconciliation with User Requirements

24.1 Introduction

The Data Quality Objectives (DQOs) process is an important planning tool in determining the objectives of an environmental data operation, understanding and agreeing upon the allowable uncertainty in the data, and optimizing the sampling design. Reconciliation with the DQOs involves determining whether DES has attained the DQOs and that the data is adequate for its intended use. This process of evaluating the data against the DQOs is known as Data Quality Assessment ("DQA"). DQA is a key part of the assessment phase of the data life cycle which is very similar to the ambient air QA life cycle. As the part of the assessment phase that follows data validation and verification, DQA determines how well the validated data can support the intended use. Guidance on the DQA process can be found in the document titled *Guidance for Data Quality Assessment (EPA QAIG-9).* This document focuses on evaluating data for fitness in decision-making and also provides many graphical and statistical tools. DQA is built on a fundamental premise: "Data *quality, as a concept, is meaningful only when it relates to the intended use of the data".* By using the DQA Process, one can answer two fundamental questions:

- Can the decision (or estimate) be made with the desired confidence, given the quality of the data set?

- How well can the sampling design be expected to perform over a wide range of possible outcomes?

As is described in *EPA QAIG-9,* the DQA process is comprised of five steps. The steps involved are detailed below.

24.2 Review DQOs and Sampling Design

Element 7 of this QAPP contains the details for the development of the DQOs, including defining the primary objective of the PM2.5 ambient air monitoring network ($PM_{2.5}$ NAAQS comparison), translating the objective into a statistical hypothesis (3-year average of annual mean PM2.5 concentrations less than or equal to 15 $\mu g/m^3$ and 3-year average of annual 98th percentiles of the PM2.5 concentrations less than or equal to 65 $\mu g/m^3$), and developing limits on the decision errors (incorrectly conclude area in non-attainment when it truly is in attainment no more than 5% of the time, and incorrectly conclude area in attainment when it truly is in non-attainment no more than 5% of the time).

Element 10 of this QAPP contains the details for the sampling design, including the rationale for the design, the design assumptions, and the sampling locations and frequency. If any deviations

from the sampling design have occurred, these will be indicated and their potential effect carefully considered throughout the entire DQA.

24.3 Conduct Preliminary Data Review

Review QA reports, calculate basic statistics, and generate graphs of data. Use this information to learn about the structure of the data and identify patterns, relationships, or potential anomalies. DES and EPA will perform a preliminary data review to uncover potential limitations to using the data, to reveal outliers, and generally to explore the basic structure of the data. The first step is to review the quality assurance reports. The second step is to calculate basic summary statistics, generate graphical presentations of the data, and review these summary statistics and graphs.

24.4 Select the Statistical Test

The primary objective for the PM2.5 mass monitoring is determining compliance with the PM2.5 NAAQS. As a result, the null and alternative hypotheses are:

$$H_0 : X \leq 15\ \mu g/m^3 \text{ and } Y \leq 65\ \mu g/m^3$$
$$H_A : X > 15\ \mu g/m^3 \text{ or } Y > 65\ \mu g/m^3$$

where X is the three-year average PM2.5 concentration and Y is the three-year average of the annual 98th percentiles of the PM2.5 concentrations recorded for an individual monitor. The exact calculations for X and Y are specified in *40 CFR Part 50 Appendix N*. The null hypothesis is rejected, that is, it is concluded that the area is not in compliance with the PM2.5 NAAQS when the observed three-year average of the annual arithmetic mean concentration exceeds 15.05 $\mu g/m^3$ or when the observed three-year average of the annual 98th percentiles exceeds 65.5 $\mu g/m^3$. If the bias of the sampler is greater than -10% and less than +10% and the precision is within 10%, then the error rates *(Type I and Type II)* associated with this statistical test are less than or equal to 5%. The definitions of bias and precision will be outlined in the following step.

24.5 Evaluate/Verify Assumptions of Statistical Test

The assumptions behind the statistical test include those associated with the development of the DQOs in addition to the bias and precision assumptions. Their method of verification will be addressed in this step. Note that when less than three years of data are available, this verification will be based on as much data as are available.

The DQO is based on the annual arithmetic mean NAAQS. For each primary sampler, DES/EPA will determine which, if either, of the PM2.5 NAAQS is violated. In the DQO development, it was assumed that the annual standard is more restrictive than the 24-hour one. If there are any samplers that violate only the 24-hour NAAQS, then this assumption is not correct. The seriousness of violating this assumption is not clear. Conceptually, the DQOs can be developed based on the 24-hour NAAQS and the more restrictive bias and precision limits selected. However, it will be assumed that the annual standard is more restrictive, until proven otherwise.

Normal distribution for measurement error. Assuming that measurement errors are normally distributed is common in environmental monitoring. DES/EPA has not investigated the sensitivity of the statistical test to violation of this assumption; although, small departures from normality generally do not create serious problems. DES/EPA staff will evaluate the reasonableness of the normality assumption by reviewing a normal probability plot, calculating the Shapiro-Wilk W test statistic (if sample size less than 50), and calculating the Kolmogorov-Smirnoff test statistic (if sampler size greater than 50). All three techniques are provided by standard statistical packages (such as *STATISTICA* and *S-PLUS*) and by the statistical tools provided in *EPA QA/G-9D: Data Quality Evaluation Statistical Tools*[1] *(DataQUEST)*. If the plot or statistics indicate possible violations of normality, a determination of the sensitivity of the DQOs to departures in normality will be made. When ever possible appropriate parametric statistical tests will be used, unless the data violate parametric test assumptions. If parametric test assumptions are violated, then non-parametric statistical tests will be employed. Decision error can occur when the estimated 3-year average differs from the actual, or true, 3-year average. This is not really an assumption as much as a statement that the data collected by an ambient air monitor is stochastic, meaning that there are errors in the measurement process, as mentioned in the previous assumption.

The limits on precision and bias are based on the smallest number of required sample values in a 3-year period. In the development of the DQOs, the smallest number of required samples was used. The reason for this was to ensure that the confidence was sufficient in the minimal case; if more samples are collected, then the confidence in the resulting decision will be even higher. For each of the samplers, staff from DES will determine how many samples were collected in each quarter. If this number meets or exceeds 12, then the data completeness requirements for the DQO are met.

The decision error limits were set at 5%. Again, this is more of a statement. If the other assumptions are met, then the decision error limits are less than or equal to 5%.

Measurement imprecision was established at 10% CV. The CV calculated in Step 2 will be reviewed for each sampler. If any exceed 10%, DES will determine the sensitivity of the DQOs to larger levels of measurement imprecision.

Achievement of bias and precision limits. DES/EPA staff will check the assumption that at the three-year level of aggregation the sampler bias is in [-10%,10%] and precision is less than 10%. The data from the collocated samplers will be used to estimate quarterly, annual, and three-year bias and precision estimates even though it is only the three-year estimates that are critical for the statistical test.

Since all the initial samplers in the network are FRMs, the samplers at each of the co-located sites have identical method designations. As such it will be impossible to determine which of the co-located samplers is closer to the true PM2.5 concentration. The data generated from the co-located samplers will be used to estimate precision. A bias measure will also be calculated but it can only describe the relative difference of one sampler to the other, not definitively indicate which sampler is more "true." Algorithms for calculating precision and bias are described below. These are similar, but differ slightly, from the equations in *40 CFR Part 58 Appendix A*. These have been developed with assistance from OAQPS/EMAD.

Before describing the algorithm, first some ground work. When less than three years of collocated data are available, the three-year bias and precision estimates must be predicted. DES/EPA's strategy for accomplishing this will be to use all available quarters of data as the basis for projecting where the bias and precision estimates will be at the end of the three-year monitoring period. Three-year point estimates will be computed by weighting the quarterly components, using the most applicable of the following assumptions:

- Most recent quarters precision and bias are most representative of what the future quarters will be.
- All previous quarters precision and bias are equally representative of what the future quarters will be.
- Something unusual happened in the most recent quarter, so the most representative quarters are all the previous ones, minus the most recent.

Each of these scenarios results in weights that will be used in the following algorithms. The weights are shown in Table 24.1 where the variable Q represents the number of quarters for which observed bias and precision estimates are available. Note that when Q=12, that is, when there are bias and precision values for all of the quarters in the three-year period, then all of the following scenarios result in the same weighting scheme.

Table 24.1 - Weights for Estimating Three-Year Bias and Precision

Scenario	Assumption	Weights
1	Latest quarter most representative	w_q = 12-*(Q*-1*)* for latest quarter, w_q = 1 otherwise

2	All quarters equally representative	$w_q = 12/Q$ for each quarter
3	Latest quarter unrepresentative	$w_q = 1$ for latest quarter, $w_q = 11/(Q\text{-}1)$ otherwise

In addition to point estimates, DES/EPA staff will calculate confidence intervals for the bias and precision estimates. This will be accomplished using a re-sampling technique. The protocol for creating the confidence intervals are outlined in Box 24.1.

Box 24.1 - Method for Estimating Confidence in Achieving Bias and Precision DQOs

Let *Z* be the statistic of interest (bias or precision). For a given weighting scenario, the re-sampling will be implemented as follows:

1. Determine *M*, the number of collocated pairs per quarter for the remaining 12-*Q* quarters (default is *M*=15 or can use *M*=average number observed for the previous *Q* quarters.
2. Randomly select with replacement *M* collocated pairs per quarter for each of the future 12-*Q* quarters in a manner consistent with the given weighting scenario.
   - Scenario 1: Select pairs from latest quarter only.
   - Scenario 2: Select pairs from any quarter.
   - Scenario 3: Select pairs from any quarter except the latest one.

   Result from this step is "complete" collocated data for a three-year period, from which bias and precision estimates can be determined.
3. Based on the "filled-out" three-year period from step 2, calculate three-year bias and precision estimate, using Equation 1 where $w_q = 1$ for each quarter.
4. Repeat steps 2 and 3 numerous times, such as 1000 times.
5. Determine *P*, the fraction of the 1000 simulations for which the three-year bias and precision criteria are met. *P* is interpreted as the probability that the sampler is generating observations consistent with the three-year bias and precision DQOs.

The algorithms for determining whether the bias and precision DQOs have been achieved for each sampler follow.

Bias Algorithm

1. For each measurement pair, estimate the percent relative bias, d_i. The equation is

$$d_i = \frac{Y_i - X_i}{(Y_i + X_i)/2} x100$$

where X_i represents the concentration recorded by the primary sampler, and Y_i represents the concentration recorded by the collocated sampler.

2. Summarize the percent relative bias to the quarterly level, $D_{j,q}$, according to where $n_{j,q}$ is the number of collocated pairs in quarter q for site j.

$$D_{j,q} = \frac{1}{n_{j,q}} \sum_{i=1}^{n_{j,q}} d_i$$

3. Summarize the quarterly bias estimates to the three-year level using

$$\hat{D}_j = \frac{\sum_{q=1}^{n_q} w_q \quad D_{j,q}}{\sum_{q=1}^{n_q} w_q}$$

where n_q is the number of quarters with actual collocated data and w_q is the weight for quarter q as specified by the scenario in Table 24.2.

4. Examine $D_{j,q}$ to determine whether one sampler is consistently measuring above or below the other. To formally test this, a non-parametric test will be used. The test is called the Wilcoxon Signed Rank Test and is described in *EPA QA/G-9*. If the null hypothesis is rejected, then one of the samplers is consistently measuring above or below the other. This information may be helpful in directing the investigation into the cause of the bias.

Precision Algorithm

1. For each measurement pair, calculate the coefficient of variation according to the equation below:

$$CV_i = \frac{|d_i|}{\sqrt{2}}$$

2. Summarize the coefficient of variation to the quarterly level, $CV_{j,q}$, according to

$$CV_{j,q} = \sqrt{\frac{\sum_{i=1}^{n_j} CV_i^2}{n_{j,q}}}$$

where $n_{j,q}$ is the number of collocated pairs in quarter q for site j.

3. Summarize the quarterly precision estimates to the three-year level using

$$\hat{CV}_j = \sqrt{\frac{\sum_{q=1}^{n_q} (w_q CV_{j,q}^2)}{\sum_{q=1}^{n_q} w_q}}$$

where n_q is the number of quarters with actual collocated data and w_q is the weight for quarter q .

4. If the null hypothesis in the Wilcoxon signed rank test was not rejected, then the coefficient of variation can be interpreted as a measure of precision. If the null hypothesis in the Wilcoxon signed rank test was rejected, the coefficient of variation has both a component representing precision and a component representing the (squared) bias.

Confidence in Bias and Precision Estimates

1. Follow the method described in Box 24.1 to estimate the probability that the sampler is generating observations consistent with the three-year bias and precision DQOs. The re-sampling must be done for each collocated site.

Summary of Bias and Precision Estimation

The results from the calculations and re-sampling will be summarized in Table 24.2. There will be one line for each site operating a collocated sampler.

Table 24.2 - Summary of Bias and Precision				
Collocated Site	Three-year Bias Estimate (Equation. 1)	Three-year Precision Estimate (Equation. 2)	Null Hypothesis of Wilcoxon Test Rejected?	*P* (Box 24-1)
A1				
B1				

24.6 Draw Conclusions from the Data.

Before determining whether the monitored data indicate compliance with the PM2.5 NAAQS, there must be a determination whether or not the assumptions upon which the statistical test is based are violated. This can be easily checked in Step 5 because of all the work done in Step 4. In particular, as long as in Table 24.3, the three year bias estimate is in the interval [-10%,10%], and the three year precision estimate is less than or equal to 10%. Then, the assumptions underlying the test appear to be valid. As a result, if the observed three-year average PM2.5 concentration is less than 15 $\mu g/m^3$ and the observed three-year average 98th percentile is less than 65 $\mu g/m^3$, the conclusion is that the area seems to be in compliance with the PM2.5 NAAQS, with an error rate of 5%.

If any of the assumptions have been violated, then the level of confidence associated with the test is suspect and will have to be further investigated.

If the conclusion from the DQA process is that each of the PM2.5 mass monitors are operating with less than 10% bias and 10% precision, then DES will pursue action to reduce the QA/QC burden. The basic idea is that once it has been demonstrated that the sites can operate within the precision and bias limits, it is reasonable to dedicate some of the PM2.5 QA/QC resources to other duties/tasks, such as modifying its QA monitoring, or reducing some of its QC samplers, or monitoring frequency.

If and when the data from at least one of the co-located sites violates the DQO bias and/or precision limits, then an investigation will be conducted to uncover the cause of the violation. If all of the co-located sites violate the DQOs (across monitor designations), the cause may be at the network level (operator training) or higher (laboratory QC, problems with method designation). If only one site violates the DQOs, the cause is more likely specific to the site (particular operator, problem with site). The tools for getting to the root of the problem include: data from the co-located network (New Hampshire, nearby state reporting organizations, national), data from FRM performance evaluations (New Hampshire, nearby reporting organizations, national), QC trails. Some particular courses of action include Determining the level of aggregation at which DQOs are violated. The DQA process can identify which monitors are having problems since the DQOs were developed at a monitor level. To determine the level at which corrective action is to be taken, it must be determined whether the violation of the

DQOs is due to problems unique to one or two sites, unique to New Hampshire or caused by a broader problem, like a particular sampler demonstrating poor QA on a national level. DES understands that AIRS will generate QA reports summarizing bias and precision statistics at the national and reporting organization levels, and by method designation. These reports will assist DES in determining the appropriate level at which the DQOs are being violated. The procedure for determining level of violation is:

- Review national reports for the method designations for which DES DQA process indicated a violation. If large bias or imprecision is seen at the national level, DES will request assistance from the Regional Office and OAQPS. If no problem seen at national level, DES/EPA will proceed looking at the QA reports specific to its neighboring reporting organizations.

- Review neighboring reporting organizations' precision and bias reports for the method designations for which DES' DQA process indicated a violation. If large bias or imprecision is seen in the neighboring organizations, DES/EPA will request assistance from the Regional Office. If no problem seen in the neighboring reporting organizations, DES/EPA will proceed looking at the QA reports specific to itself.

- Within New Hampshire, if the violations occur across method designations, then laboratory QC and training will be reviewed.

- Within New Hampshire, if the violations occur for only one method designation, the FRM performance evaluation data will be reviewed for confirmation with the collocated data. The FRM performance evaluation data may show that one of the monitors has a problem and must be repaired or replaced. DES/EPA will also use the national FRM performance evaluation summaries to determine if this is unique or like the national network. If the problem is similar to the national picture, then assistance will be requested from the Regional Office and OAQPS. The results from the neighboring reporting organizations will also be reviewed. If the violations seem unique to New Hampshire, then DES/EPA will continue investigating all the pieces that comprise the data.

- If a violation of the bias and precision DQOs is found, Staff from DES/EPA Region I will remain in close contact with the Office of Environmental Measurement and Evaluation both for assistance and for communication.

- DES/EPA will continue to review extensively the quarterly QA reports and the QC summaries until the bias and precision limits are attained.